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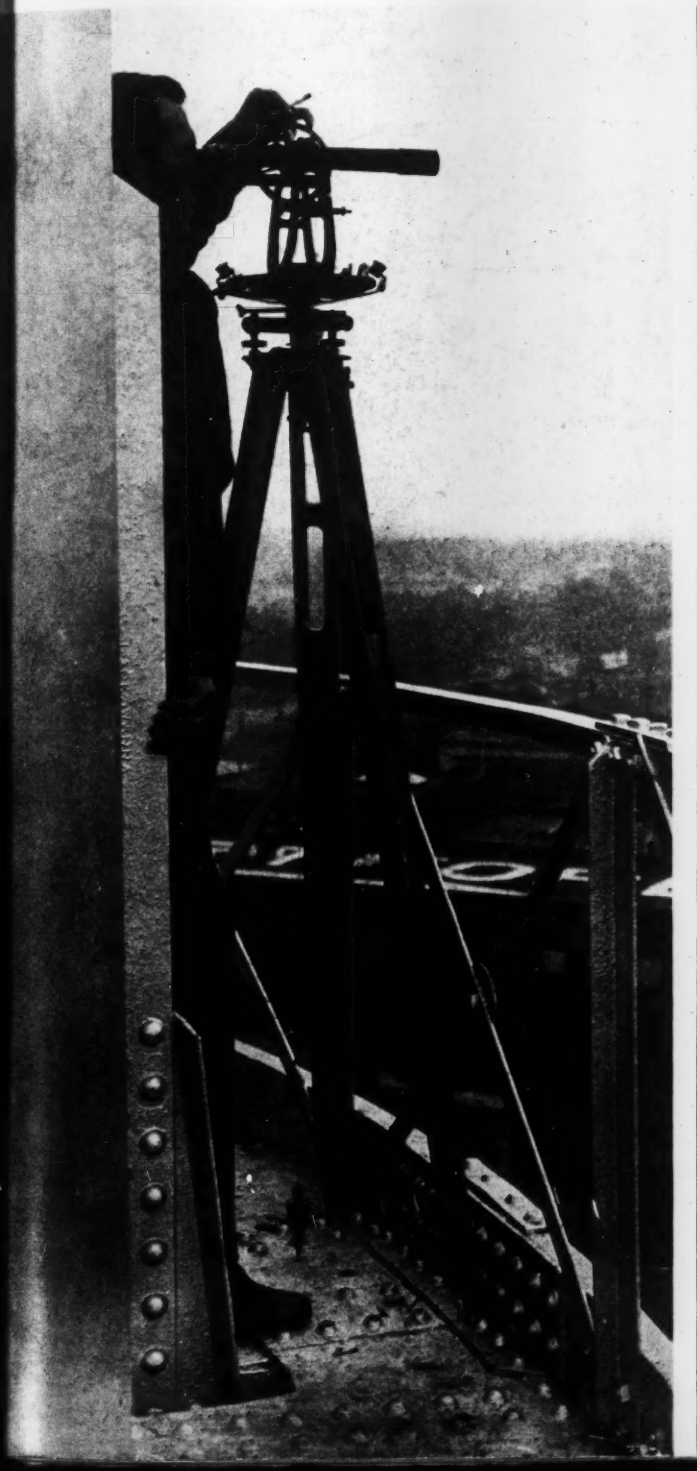

An Issue Devoted to

MUNICIPAL PUBLIC WORKS

Problems of City Growth
F. J. Klaus

Municipal Works Revival
E. O. Griffenhagen

Geodetic Survey for Better Planning
Charles W. Cooke

Improved Sewers for El Paso
H. G. Stacy and F. M. Veatch

Modernization of Brick Paving
Roy L. Phillips

Street Lighting and Safety
Paul H. Goodell

ALSO: Buffalo Solves Its Sewage Problem . . . Refuse Disposal in a Small City . . . Air Conditioning and Sewers . . . Traffic Regulation in Iowa Cities

An important municipal employee at work at a lofty triangulation station used in geodetic survey of Hartford, Conn., metropolitan area

The Country Beyond .. through

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Bridge Railing

WROUGHT IRON for longer service

The concrete piers of the Hampton Boulevard Bridge at Norfork are covered with Byers Wrought Iron plates in the tide-range to protect against spalling.

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You will note that while the railing illustrated offers maximum safety, it also permits a view of the country beyond.

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May we tell you more about this bridge — the Hampton Boulevard Bridge at Norfork — and about bridge railing and bridge protection? A special illustrated report, "The Use of Wrought Iron in Bridge Construction," has just been republished. If you wish a copy write our Engineering Service Department at Pittsburgh. A. M. Byers Company. Established 1864. Pittsburgh, Boston, New York, Philadelphia, Washington, Chicago, St. Louis, Houston.

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A MOMENT WITH THE PUBLISHERS

Design for COMMUNITY LIVING

ONE privilege of air travel is the opportunity to see a city as a complete whole. While this is more true of the smaller community, it is quite possible to get even a large city wholly under one's eye. While all may not be able thus to bring the city within the scope of the physical eye, it is important that more of us should have a mental concept of the modern city as a complete and coordinated organism.

Time was when the town or city was but a collection of individual buildings, so closely grown up that they had come to share certain community facilities. Originally the provision of each facility was an independent enterprise, undertaken from time to time to meet a demand for that particular service. In those days a community supply of water, the digging of drainage ditches or sewers, the opening and maintenance of streets, the building of bridges and all the other public facilities were quite uncoordinated: they developed independently to meet the particular needs of the place and the hour.

TODAY all this is changed. The modern city is a vast, costly and complicated plant, the product of which is a community living of a certain standard. The vision with which that plant has been laid out, the technical ability with which its component parts have been designed and articulated, the integrity and skill with which they have been constructed and the efficiency with which they are administered will determine the standard and cost of that living. The prosperity of its industrial producers and merchants, the convenience and comfort of its inhabitants and, in a large measure, the health and security of everyone within its gates, will be measured by the competence of those who build and administer the city.

No longer are the city streets merely the beaten trails of a settlement; they have become the throbbing circulatory system of a complex organism. No longer is a water supply but the enlargement of a family well or pipe line; it has become a life-line of structures and devices to tap the waters of remote sources. No longer is sanitation a matter of a few ditches or sewers to supplement the natural drainage; to safeguard the health of the people, it must invoke the science of the chemist and bacteriologist along with that of the hydraulic engineer.

These and many more technical services are involved in the factory for community living that we call the city. Moreover, it is not enough that each of these be in itself adequate. Each must be so coordinated with the others as to provide a balanced establishment, proportioned to the community needs—always at least equal to them, yet not so far ahead as to involve economic waste.

NATURALLY our progress in each of the municipal services reflects the advance of its scientific technique. More far-seeing coordination in design reflects the development of city and regional planning. The extraordinary magnitude of many great works reflects the progress of construction practice and equipment; it often is forgotten that many of them hardly could have been built a generation ago simply for lack of the requisite construction technique and equipment. But we have only begun with the task of coordinating administration on a scale adequate to the need and commensurate with our technical progress.

This increasing requirement that we administer the modern city as a balanced operating plant rather than as a mere collection of public facilities offers to the municipal engineer in whatever sphere the incentive to cooperate more closely with his fellows in order to achieve more economical city administration with greater convenience and well-being for city dwellers. Only as those who can and will do this are given increasing influence in the overall management of their cities, can we hope even to maintain our present scale of community living, to say nothing of raising it to a higher plane.

Willard Chevalier

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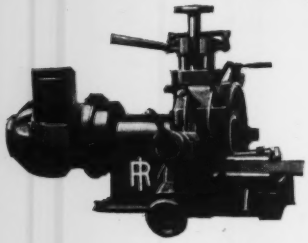
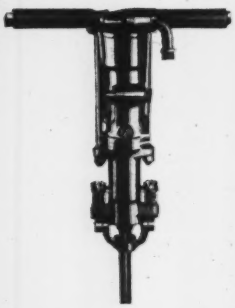
ROCK AHEAD

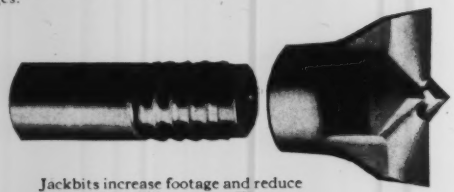
In the large view above are two Type D Wagon Drills capable of 10-ft. steel changes, and several Jackhamers running off the Two-Stage, Air-Cooled Portable Compressor. Below is the new lightweight and flexible FM Wagon Mounting using the fast and powerful X-71 Drill. It permits 6-ft. steel changes.



By resharpening with the Jackbit Grinder, contractors are obtaining up to 200% more footage from bits.



The JA-45 Jackhamer is a fast driller that uses considerably less air. If your compressor now operates two 55-lbs. drills—substitute three JA-45 Jackhamers and get ⅓ more drilling.



Jackbits increase footage and reduce drill-steel handling costs. They are available in all sizes and types; most sizes can be resharpened 1 to 3 times.

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What Do You Think about use charges for highways; future federal aid; express roads; freeway intersections? Whatever your thoughts on these and nine other puzzling road problems, they are sure to be stimulated by a series of articles by acknowledged road authorities to be published weekly beginning with the October 1 issue.

Unusual and distinctive use of Atlas White terrazzo in the residence of Mrs. Edwin Ruud, Hillcrest Road, Pittsburgh. Maximilian Nirdlinger, Architect; Patrizio Art Mosaic Co., Terrazzo Contractor, both of Pittsburgh

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ENGINEERING NEWS-RECORD

September 24, 1936

PHYSICAL NEEDS of the modern city have multiplied as a result of deferred improvements during the period of depression.

Municipal Works Revival

By E. O. Griffenhagen

Senior Partner, Griffenhagen & Associates Consultants on Public Administration and Finance Chicago

DEFICITS in the way of deferred municipal maintenance and delayed construction have accumulated in the static years of depression. Recent trends, however, indicate an encouraging prospect for early resumption of a large program of rehabilitation and modernization of public facilities.

In order to take fullest advantage of this revival of activity, long range planning and careful budget-making are vital requisites. In addition, the simplification of local governmental organization and the adoption of a merit or career system for municipal employees are necessary reforms in expediting an orderly program of progress.—EDITOR.

THE RAPID GROWTH of the urban population of the country during the last century is a well-known social phenomenon. Figures on the shift that has taken place from the rural areas to the cities are astounding. In 1820 only 7 per cent of the total population was to be found in cities of over 2,500, and in 1930 this fraction had grown to 56.2 per cent. The growth in metropolitan areas has been even more striking. In 1820 only 1.3 per cent of the population was to be found in metropolitan districts of 100,000 or over; but in 1930 these great urban centers had 44.6 per cent of the total.

That the cities in which these millions live may be safe, healthy, comfortable and as attractive as possible is the concern of the municipal engineer and public works official. He is held responsible not only for maintenance of the municipal plant but for supplying new and better facilities to meet present-day demands and to parallel progress in other fields of engineering. In recent years he has had rather an unhappy time of it. The demand for new conveniences and services has not diminished, but there has been little or no local money with which to meet these demands. Taxpayers have been unable to pay, financial officers have been forced to retrench, municipal credit has suffered and borrowing has, until recently, been expensive.

The financial officers of cities, in their attempts to balance budgets in the face of low revenues and poor collections, have in general followed the policy of conserving available funds for the continuation of services considered by them as essential, such as police and fire, and of omitting or deferring repair and maintenance items that normally would have been considered necessary to any truly economical administration of public works.

As a result cities have acquired heavy deficits in the form of unfulfilled needs for both construction and manitenance —deficits not recorded on the books of account but just as real as any liabilities listed in the balance sheet. States and urban counties have been placed in the same position.

The volume of deferred construction and repair and of new public works that could be justified by the community benefits they bestow has reached striking proportions. As one estimate of the total we have an inventory of needs made by the federal Public Works Administration in the spring of 1935 that listed projects totaling nearly $14,000,000,000 in cost. This total was divided as shown in Table I.

Municipal engineers have all along been keenly aware of the requirements of their communities and have planned for the day when circumstances would permit them to proceed to supply those requirements. That day seems to have come; the financial picture is changing.

A number of signs indicate that money will be available in reasonable amounts for the gradual reduction of the hidden deficit in the form of deferred maintenance and construction. And the managers of fiscal affairs are recognizing the imperative need of meeting the demand for more modern facilities.

Prominent among the statistical facts and signs that should give encouragement to those whose construction plans have been held up for years are those that relate to the improvement in tax collections and municipal credit.

While progress in the collection of current levies in the average city is not yet striking, the trend is definitely up and back taxes are coming in at a rate to more than make up for the current delinquency.

Dun & Bradtstreet (Frederick L. Bird, author) give the following median figures for the year-end delinquency in the collection of taxes for each of the years 1930 to 1935 in 150 cities of over 50,000 population. The second column is in terms of per cent of the year's levy.

1930	10.15
1931	14.60
1932	19.95
1933	26.35
1934	23.05
1935	18.00

The collections on back taxes has shown an even greater improvement and last year they more than offset the delinquencies in that year's levies. The median ratio for 1935 of all collections of current and back taxes in 111 large cities was 101 per cent of the year's levy. Seattle collected 122.9 per cent!

At the end of 1935, 108 cities showed a median ratio of 48.4 per cent of accumulated uncollected taxes to the current levy. In other words, the average city has about one-half of one year's levy owing to it.

The very political and economic uncertainties that have made "business" hesitate to venture forth and draw on the huge surplus of capital awaiting investment seem to be making "municipals" relatively more attractive to the bond buyer. He realizes that, after all, local government must go on and in one way or another its real needs will be financed and its debts paid through exercise of the taxing power.

In Table II, taken from the *Compendium of the Commercial & Financial Chronicle,* June, 1936, is shown the trend of interest rates on state and municipal bonds from 1926 through 1935.

Obviously the rapid move in 1934 and 1935 to attractively low interest rates augurs well for the securing of construction money in the immediate future. It has already had its effect in facilitating refunding operations which in turn have redounded to the improvement of municipal credit. And its more direct effect has been to increase the volume of bond borrowings to provide money for state and municipal construction. The trend is indicated by the comparative figures for new capital raised for non-federal public works in the first seven months of the years 1934, 1935, and 1936, as shown in Table III.

Another factor that should offer encouragement, particularly to city street department men, is the growing practice of state governments to share with municipalities the motor vehicle fuel taxes they raise. Motor vehicle revenues are taking on great importance in providing resources for states, counties and cities with which to carry on construction work. The only cloud on the horizon for construction men is the strong move to divert such revenues to other purposes, particularly to help finance unemployment relief.

It is this relief problem that injects the sour note when the budget maker starts to sing that happy days are here again. If the federal government carries out its promise (or threat) "to get out of the relief business" and moves toward a balancing of the national budget by letting local governments take over more and more of the responsibility and the expense of caring for the millions of unemployed, then the states and cities will have to deal with a new and heavy drain on their resources. They must either secure additional revenues or go through a new period of budget cutting that may mean a further postponement of badly needed public works.

TABLE I—INVENTORY OF PUBLIC WORKS NEEDS MADE BY PWA IN 1935

Type of Construction	Millions of Dollars	Per Cent of Total
Waterworks	864	6.3
Sewers	947	6.9
Streets and Highways	2.873	20.7
Heavy structures	2.904	20.9
Buildings—schools	943	6.0
Buildings—all other	1.303	9.3
Power (elect., gas, etc.)	592	4.4
Airports	44	0.3
Grade crossings	577	4.1
Recreation facilities	348	2.5
Drainage, flood control, irrigation, and reclamation projects	1.775	12.9
Miscellaneous	768	5.6
	13.938	

TABLE II—PERCENTAGES OF TOTAL STATE AND MUNICIPAL BOND SALES AT THE VARIOUS RATES OF INTEREST DURING THE LAST 10 YEARS

Year	3%	3½%	4%	4¼%	4½%	4¾%	5%	Above 5%
1926	.....	.01	15.52	21.02	**25.05**	5.58	15.72	14.55
1927	1.08	.67	**23.94**	21.26	22.26	5.24	11.94	10.59
1928	.....	2.60	25.77	**27.17**	19.87	4.80	10.60	7.84
1929	.22	4.55	7.48	9.33	**31.43**	**9.22**	**17.50**	19.59
1930	.13	4.04	22.70	21.94	**22.93**	**10.11**	10.45	6.51
1931	7.34	14.44	19.20	**24.79**	15.66	4.09	7.89	6.11
1932	3.69	2.19	8.04	6.59	17.81	8.64	14.32	**37.89**
1933	9.07	13.03	**25.22**	9.19	9.83	4.14	11.66	14.94
1934	**30.25***	13.48	20.94	5.74	8.01	4.33	9.41	5.72
1935	**46.87***	**17.11**	19.14	3.32	4.09	1.83	2.79	.74

*Includes 3% and under. The figures in bold face type show at which interest rates the largest volume of bonds was sold during the year.

TABLE III—CAPITAL RAISED FOR NON-FEDERAL PUBLIC WORKS

	Jan.-July 1934	Jan.-July 1935	Jan.-July 1936
Total non-federal financing	$253,280,000	$473,797,000	$354,785,000
PWA allotments & RFC bond purchases	197,925,000	222,456,000	44,669,000
State and municipal bonds	55,355,000	251,341,000	310,116,000

Reforms in public management

One of the few gains that may be traced to the recent years of economic and industrial confusion and one of the few hopeful signs for the development of a new and better order of things in the field of public affairs is the pronounced increase in interest that people are taking in the administration of government. So far, it is true, there has been more interest than knowledge. But understanding will come. Public opinion is already taking form in support of a number of improvements and reforms in public management that hold possibilities of great and especial benefit for engineers and public works officials. Among these is the adoption of the practice of long-range planning of engineering works; the correction of budget-making procedure to include annual provision for new construction and for the adequate maintenance of existing facilities; the simplification and modernization of the administrative structure of municipal, and particularly metropolitan, governments; and the establishment of the merit principle in the selection and protection of the personnel of the public service.

Those whose careers lie in the field of municipal engineering should provide not only enthusiastic support but active leadership in these movements. A few words regarding each may be in order.

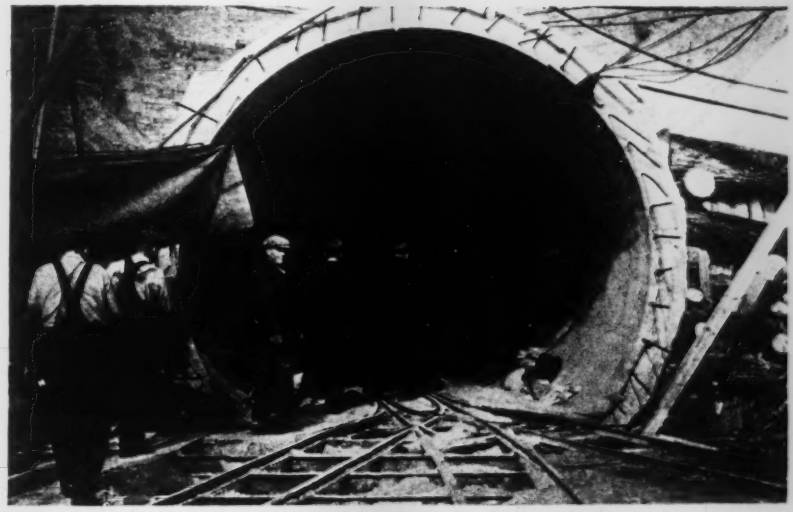
The adoption of the principle of long-range planning should come first among the objectives of those who seek to lay a foundation for an orderly and stable public works administration. It is necessary as a basis for financial planning. It provides the only way to bring before the appropriating bodies and budget authorities the necessity of meeting currently *all* of the annual needs of the community. It is the first step toward a pay-as-you-go policy which will in itself add 50 per cent to the money available for maintenance and repair expenses and capital outlays. The less money that is available, the more important it becomes that planning be done thoughtfully, wisely and skillfully. First things should come first and design should consider future developments and maintenance costs.

As a complement to a policy of long-range physical planning is the extension and broadening of the "budget" idea of financial planning to include provision each year for that year's fair share of capital outlays. It is perfectly absurd for a community to assume that the repairs and extensions to physical plant needed this year will be the last and that the cost should be spread over the years to come because there will be no need for money in those later years for anything but interest and debt retirement. It is time for both financial and public works officials to face realities and let each year pay for the maintenance, the depreciation and the obsolescence that accrues in that year and to spread the costs of new construction over the shortest period practicable.

But both the planning of construction and the planning of financing are greatly obstructed in many communities by the complexity and confusion in the organization structure of local governments. Particularly in metropolitan areas is comprehensive planning exceedingly difficult because of the decentralization of authority among a multitude of spending units divided by purely arbitrary political lines and because of the confusion and conflict in financing resulting from the superimposing of several layers of government.

The engineering profession and the construction industry should line up with those civic forces that would reorder the scheme of government. They would thus greatly expedite an orderly program for the modernization and beautification of our cities. If those in charge of public affairs do not make progress in the simplification of the governmental structure and in the other directions suggested they will have to face the effects of further taxpayers' strikes, tax-limitation laws, homestead exemptions, state veto of local borrowing and spending and similar measures.

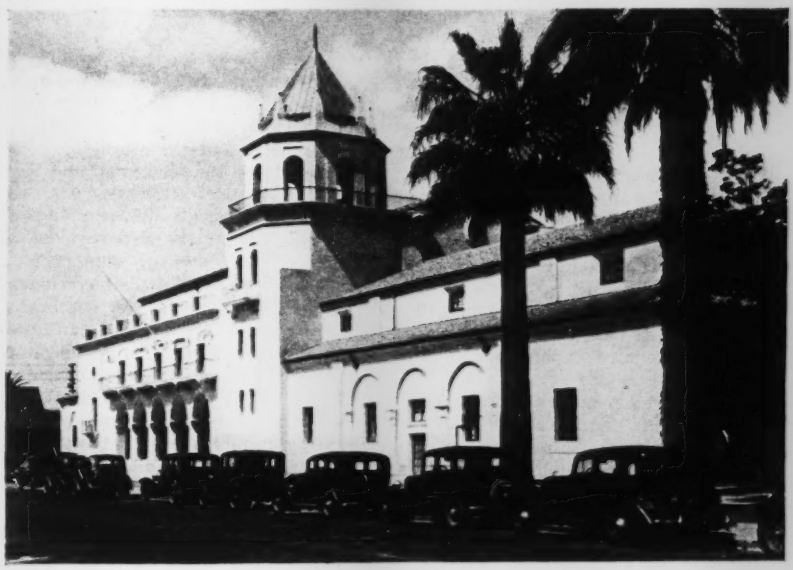
But even with careful planning, better budgeting and good organization the citizens of our municipalities will not get the best service and municipal engineers will not achieve professional independence and adequate recognition until the way is opened to them for a sure and secure career on their merits. Whether we call it the "civil service system" or the "merit system" (or the "career system" as the author proposed to the Assembly of Civil Service Commissions in 1934) we must establish by law and tradition the principle that a man charged with the design, construction or maintenance of public works shall be selected solely because of his fitness for the work he is to do and the responsibility he is to carry, shall be free to serve the public interest without interference and shall be secure in his place during good behavior. There are hopeful signs that public opinion will soon demand the acceptance of this principle in the administration of government.



BACK TO WORK on long deferred construction will be a familiar scene as municipalities take advantage of capital now available at extremely low rates of interest.

CONSTRUCTION of adequate parking areas is just one of the many facilities badly needed in every city.

LONG RANGE PLANNING exemplified by the San Jose municipal auditorium the first unit of a civic center that will be completed as funds become available.



Looking Ahead to City Growth Problems

A city engineer enumerates the deficiencies and changes in community facilities that call for attention as we enter a new period of progressive municipal development

By Fred J. Klaus
City Engineer, Sacramento, Calif.

AFTER HAVING SPENT the last few years backsighting on events, Sacramento, Calif., like many other cities, has now reversed its telescope and is peering into the problem of the future.

The immediate problems for most cities are akin to those we were unable to meet successfully during the years of restricted budgets, namely, the regular and proper maintenance of most of our physical facilities and equipment. It is especially important that these be cared for immediately as the depreciation in most items is increasing rapidly and consequently repairs are more costly. During the depression period we generally neglected our streets, drainage, automotive equipment and public buildings, and while these were perhaps best able to stand this lack of attention, they now demand first consideration. At the same time we must meet the challenge of providing additional facilities to match present growth and to meet future needs.

PARKWAYS AND THROUGH STREETS with grade-separated intersections are a necessary result of increasing traffic congestion.

While the depression years halted progress in most endeavors, this was not true in the field of scientific research. The development of many useful and desirable facilities has been the result, and these in turn are beginning to affect and will increasingly influence municipal problems.

Among these is air conditioning. This will involve the building departments, gas and electric utilities, and is tending to increase seriously the use and disposal of water, thus creating new loads which will require expansion of water and sewerage systems.

The growing popularity of air transportation with the increasing use of larger and faster ships will require major changes in airport construction, especially affecting landing areas, hangars and electrical appurtenances. Diesel and gas motors will be responsible for cheaper transportation on water as well as on land, and this in turn will necessitate added waterways, harbors and docks for both utility and pleasure purposes.

Radio and soon television will continue to cause revisions in police and fire department equipment, and perhaps man-power. Its use will probably be extended to become an integral part in the operation of many other city functions. It has already been responsible in many cities for the inclusion of special departments which care for radio interference, and these will have to be expanded as to personnel and equipment as advances are made.

The introduction of new types of street lighting may hasten the obsolescence of our present standards, and force us, by virtue of their efficiency, to rebuild or replace present equipment.

The growing use of automotive equipment, increasing in number, speed and weight, is attended by many problems. Parking, traffic control, street widening and intersection corrections, lighting, under or overpasses, bridges and street surface construction are examples. Some of these can be readily anticipated and solutions planned, but others due to rapid changes in traffic flows will be far more difficult.

Increase of population will of course require expansion of practically all of our facilities. Due to changes in living standards such as shorter working hours, leisure time demands will require the expansion of the facilities of health, recreation and library departments on a scale far larger than that maintained in the past.

New legislation will also add its problems for good or for evil. For instance, in California we now have a law which practically prohibits the development of new subdivisions of land. Its affect will be the construction of homes or other buildings on the many never-before-used vacant lots in cities. These lots are supplied with all city-owned improvements, and will add no immediate burden or problem to the cities. They will, however, make a very welcome added return to the treasury in taxes. Further, the restriction on expansion of area may increase property values sufficiently to justify the demolition of many old and obsolete structures for replacement with modern buildings, which will again afford greater returns in taxes. This may involve municipalities in problems of zoning, street changes or general revamping of certain sections of the older portions of the city.

A word of caution

Locally, during the past several years, we have carried on practically all necessary and considerable future improvements with a lowering tax rate and decreased assessed valuation due to efficient city management and public cooperation. It is hoped that with anticipated increased revenues we may be able to meet the future problems, paying as we go, and so avoid the great mistake of the days of the Twenties—enthusiastic voting of excessive bond issues.

Property owners are now cost- and value-minded, and all future municipal projects will be carefully analyzed with

respect to their value in cash returns or general benefit. In the execution of these projects the factors of simplicity and utmost practicability of design and construction will dominate—the day of the monument is past. The public works official can depend on the taxpayer and voter to take a greater interest in the work he is trying to do because there is wider recognition of the fact that the problems of the city are the problems of the people living in it.

Hartford Conducts A Regional Geodetic Survey

As a prelude to planning for future development, topographic surveys and maps based on precise triangulation, traverse and level networks are being made over a 100 sq. mile area

By Charles W. Cooke
Division Engineer, Hartford, Conn.

LIKE MOST AMERICAN CITIES, Hartford has grown from a small community to its present size and importance by processes which were largely unplanned. In the early days land surveys incident to the layout of streets and property boundaries were crude, as compared with modern methods, were usually concerned with small areas, and were entirely unrelated with surveys of adjoining areas. With the formation of the Metropolitan District, which includes the city of Hartford and the towns of Windsor, Bloomfield, Newington and Wethersfield, the need for an accurate, lasting basis for the coordination of all the various surveys and maps in the different divisions of the district was at once apparent. It was recognized also that the work of planning for the extension and improvement of highways and other public utilities, commonly called city planning, would require first, an accurate and reliable method map of the district and, second, similar accurate large scale topographic maps of many portions of the district.

As a result of this need the engineering department of the city of Hartford began work in 1931 on a geodetic and topographic survey of the Hartford Metropolitan District which, when completed, will provide two sets of maps of an area of about 102 sq. miles based entirely on precise triangulation, traverse and levels. To date a first order triangulation net of 29 stations has been established, computed and adjusted and a first order level net, comprising about 200 miles, has been completed. In addition, about 250 miles of precise traverse of the district has been finished. Topographic mapping with plane tables has been under way for the past three years and four-color reproductions of the plane table sheets are now being prepared. Accurate planographic maps of the towns in the district are also being made, two of which have been completed.

In beginning the triangulation survey a thorough field reconnaissance of the District area was first made in order to determine the possible location of stations and base lines. From this reconnaissance the sights and stations which were not essential to the scheme or undesirable because of probable smoke interference or horizontal refraction were rejected. Of the original 15 main stations finally adopted, six were on the roofs of substantial buildings, four were on steel tanks, and five were ground stations; in addition to the main points, six intersecting stations were included in the scheme. Ground reference monuments were provided near all but one main station, these monuments averaging about 1,000 ft. apart and the same distance from the main station. Their purpose was to furnish conveniently accessible points for connecting traverses and also to serve as reference markers for future recovery of the triangulation stations.

FIG. 1—ECCENTRIC instrument station used for observing triangulation angles.

In order to obtain the desired high strength of figure between bases it is necessary to utilize long base lines. However, because of the topography and cultural development of the district, it was difficult to find long courses that were well adapted for incorporation into the main scheme of triangles. Finally, it was decided to select two base lines on railroad rights-of-way.

Base line measurements were made by a seven-man field party, working as much as possible on cloudy days in order to secure the advantage of uniform temperature and consequently greater stability in the tape lengths. The equipment used consisted of three steel base tapes, each 50 meters in length, special thermometers for measuring tape temperatures; portable supports (copper faced bucks) for tape contacts; calibrated spring balances for applying tension to the tape; tape stretching devices; level and level rod for determining elevations of the ends of the tape; and miscellaneous minor equipment. Each section of every base was measured at least three times with different tapes, some sections requiring as many as 6 measurements to secure a satisfactory probable error of length.

Angle measurements

Observations of angles of the triangles were effected by a three-man party consisting of an observer, a recorder, and an assistant. The instrument was a 10 second repeating theodolite of American manufacture. During field use the instrument was shielded from the elements by means of a portable windshield and umbrella. The observing program consisted of measuring each angle 60 or 120 times, depending upon agreement of results obtained. These angles were recorded in sets, each set consisting of twelve repetitions.

The transfer of roof stations to ground reference monuments was effected by the regular observing party utilizing one or two small triangles,

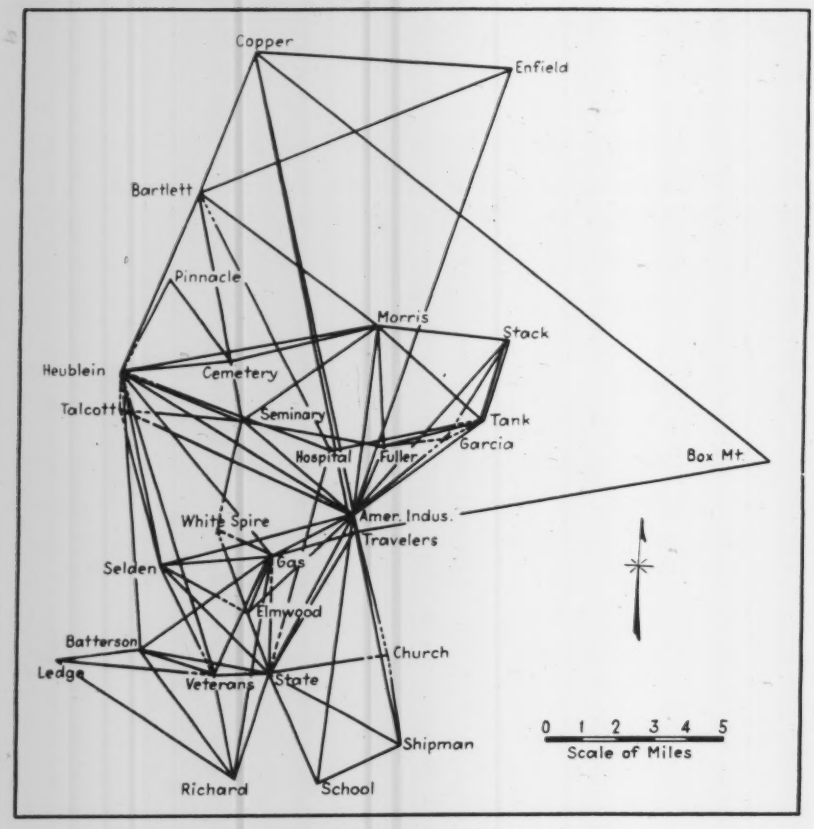


FIG. 2—TRIANGULATION NET of the Hartford Metropolitan District showing the location and distribution of the stations in the system.

each triangle having one side length measured, thus affording in every case at least one trigonometric condition. These small triangles were oriented in all cases with the main scheme through a connecting angle, that is, an angle from one of the ground markers to a distant station. This angle as well as all other angles in the transfer figure were precisely measured to insure the accuracy of the starting azimuths of the traverse originating at such stations. The short base lines between the reference monuments of these transfer triangles were measured by first order traverse parties.

Observations for astronomic azimuths were taken at Stations "American Industrial" and "School." The work was done by the regular observing party augmented by a timekeeper. The star *Polaris* was observed and at least 10 sets of angles, consisting of 6 repetitions each were measured. An accurate watch checked with Naval Observatory time through Western Union, was used to note the exact time of each pointing of the star.

Office procedure and detail

After field data were obtained the first step in the office procedure was the testing of the triangles. This provided an index to the accuracy of the work, and consisted in comparing the sum of the three measured angles of each triangle with 180 degrees. In cases where triangles failed to close satisfactorily, the field work was rechecked until acceptable results were obtained. The sine or side equation test was used to determine which angle was in error, and this method proved to be highly efficient.

The ground base lines were computed immediately after measurement in order to maintain a constant check on the accuracy of the field work; the corrections applied were inclination, temperature, and absolute length. The total probable errors of the base lines were: North Base, 1 part in 1,060,000, length 11,330 ft., divided into 5 sections; South Base, 1 part in 560,000, length 9,700 ft., divided into 4 sections. The base line computation also included transferring the ground length to the air stations, accomplished by means of small triangles at the ends of each base.

After acceptable triangle closures had been obtained and the base lengths were calculated, the least squares adjustment of the measured angles was computed. The objectives of this adjustment were: (1) to remove all angular discrepancies in the triangles, (2) to make the sines of the angles proportional to the opposite sides of each triangle thus insuring that each triangle side would check for length from whatever base it was computed, and (3) to make the sum of the squares of all the corrections to the angles a minimum. This latter requirement is based on the theory of least squares, which holds that the most probable values from any set of observations are those values which will make the sum of the squares of the corrections a minimum.

The least squares adjustment of the main stations of the triangulation included 34 condition equations, with 75 unknown quantities to be determined. These unknowns are the small corrections to the observed angles called "corrections to directions" and when applied to the observed angles give correct angles which satisfy all trigonometric conditions of the triangles. The least squares adjustment involves the transformation of condition equations to correlate equations and then to normal equations, which can be solved simultaneously by the Doolittle method of solution.

Following the major adjustment of the main stations, the six intersection stations were adjusted by similar methods to fit the main station angles and coordinates. Lengths for all the sides were then computed, based on the adjusted angles of the triangles. Each triangle side length received one or more checks by computing lengths through each figure by all possible routes.

Computing plane ordinates

The azimuth observations made at "School" and "American Industrial" were computed and after correcting for convergence of meridians from the origin of plane coordinates at "White Spire," a check in azimuth was made by carrying the azimuths of the two observations through the adjusted triangulation to "White Spire." The resulting discrepancy was 2.4 seconds. A final mean azimuth was adopted, and by using the adjusted angles of the triangles plane azimuths were computed for all the triangle sides. With these azimuths and the lengths of the triangle sides, plane coordinates were computed for all the stations. The small triangles used to transfer roof stations for ground use were then adjusted, and plane coordinates computed for the ground reference monuments.

The critical figures indicating the accuracy actually obtained are tabulated below. These criteria compare favorably with geodetic survey results obtained in other cities.

	Aver.	Max.
Strength of figure between bases	...	28.0
Triangle closure (in sec.)	1.63	4.0
Correction to direction (in sec.)	0.71	2.38
P.E. of an observed direction	0.89	...
P.E. of an observed azimuth	1.8	2.3
Base-to-base discrepancy	...	1:89,000
Azimuth discrepancy between obser.		2.5

Since the original triangulation was

made additional stations have been added to give the complete net as shown on Fig. 2.

The first order traverse which has been extended over a large part of the district is of a slightly lower order of accuracy than the triangulation, but is sufficiently accurate to serve the purpose of fixing coordinates of property corners and to control all ordinary surveys. The limiting specifications assumed for this survey were maximum position closures of one part in 20,000, and an average position closure of all lines to be not greater than one part in 30,000.

Conducting the traverse

The traverse may be considered as an amplification of the triangulation net, being a system of broken base lines. Its purpose is to furnish additional points on the ground, usually along highways, where they will be more easily available for every-day use than the widely scattered and sometimes inaccessible triangulation stations. These traverse points are coordinated positions which are necessary to control surveys for street and property locations, and for topographic mapping. The accuracy is indicated by closure of loops and by closure between triangulation stations.

The field reconnaissance in this case was just as thorough as that required for triangulation. The proposed traverse net was indicated on a map, and spaced so as to make the circuits of about the same size with the lines evenly distributed. This map was then taken into the field and an attempt made to plan the traverse system so that it would fit this ideal as near as possible, also bearing in mind the following conditions: (1) that the points should be located if possible on improved streets and in such places that the stations were not apt to be destroyed; (2) that the stations be located for convenient use by other engineers; and (3) that to obtain the necessary accuracy the lines should follow streets having low grades and with straight courses averaging lengths of 500 ft. or more.

The reconnaissance party first inspected all prospective routes selecting the streets and roads to be traversed and also approximate monument locations. The next operation was the detailed reconnaissance of each route, selecting and marking by stakes and references the actual locations for each pair of monuments. Where the road development permitted, a pair of intervisible monuments was established every half-mile. (A pair of monuments is defined as two intervisible monuments forming a regular course in the traverse line, the monuments being spaced from 500 to 1,500 ft. apart).

These monuments were of the same type as those used on triangulation, and after being placed in the ground by a special party they were allowed to settle and set before being used. The regular traverse party later established the necessary intermediate stations as the field measurements progressed, marking these points with steel pins (half-inch steel rods 2 ft. long). Each station was completely described and referred to nearby objects by witness measurements for future recovery or replacement.

The angle measurements for the traverse were executed by a four-man party, using the same theodolite employed on triangulation, and a special self-plumbing rod for station sights developed by a member of this department. Each angle was measured by repetitions 12 times, the program being 3 repetitions with telescope direct and 3 reversed from backsight, and similarly for the explement. This program resulted in a horizontal closure for each station, thus further increasing the accuracy of the measured angle.

Traverse taping was similar to triangulation base line measurement procedure, except that each course was measured but once. The equipment was the same as that used for base measurement except that 100 ft. steel tapes were substituted for the 50 meter tapes, and the tension scales were graduated in pounds instead of kilograms.

Traverse computations

The first step in making the traverse computations was the determination and distribution of angular discrepancies. Azimuths are brought to each intersection of two or more traverse lines from triangulation stations used as origins, and each azimuth value so determined is given a weight, which is in inverse proportion to the square root of the number of angles used in computing the azimuth. A weighted azimuth value is thus obtained for each intersection or junction point, and the angular discrepancies are distributed along each line by applying an equal correction to each instrument station. After the angles are so adjusted, an azimuth and bearing are computed for each course. Field measures of distances were computed as in base line computations.

After bearings and distances are computed, rectangular latitudes and departures are figured for all courses, and the lines tested for closing discrepancies between triangulation stations. The

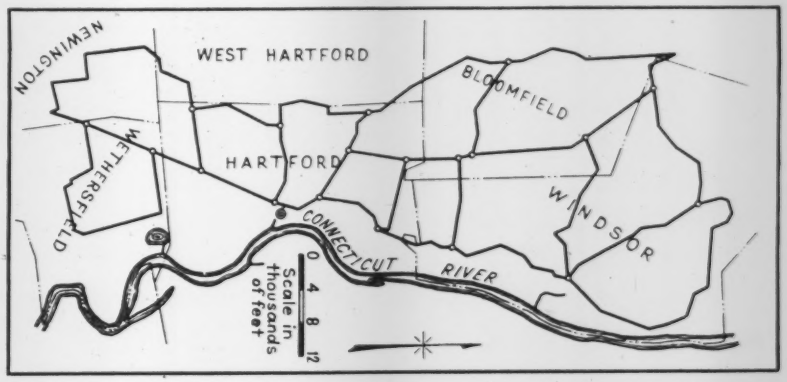


FIG. 3—FIRST-ORDER level net of the District comprising 86 miles of double-run levels with elevations established on 314 bench marks.

FIG. 4—MEASURING one of the base lines. After stretching the tape to the proper tension the measured point contacts were established on copper-faced bucks.

average angular error should not exceed $\frac{4''\sqrt{a}}{a}$ per instrument station, "a" being the number of instrument stations on the line. When all closures are within satisfactory limits, the latitude and departure discrepancies are removed by a junction point adjustment similar to the azimuth adjustment already described, and plane rectangular coordinates are computed for all stations.

These coordinates are not mathematically consistent with the lengths and bearings due to small changes in the adjustment. To remove this inconsistency a "back solution" is made. New bearings and lengths for all courses are then computed from the coordinates.

To date about 250 miles of traverse has been run, practically all of which has been first order, and with few exceptions has been capable of adjustment by the weighted mean junction point method. All traverse data have been plotted on a key map and each traverse station has a number and the control data, coordinates, bearings, and lengths which are recorded in a card file system.

Level net established

To provide permanent control for the vertical survey system, a primary net consisting of 13 circuits or loops, having a total of 85.7 miles of double-run levels, with elevations established on 314 bench marks, was completed early in the program. These level circuits followed the same routes as the traverse and the traverse monuments were used as bench marks, additional benches being established on suitable places such as door sills and water tables on buildings.

The level instrument used for this primary net was a U. S. Coast and Geodetic Survey model, with the spirit level ground to an accuracy of 1.5 sec. of arc per bubble division. The rods used were of the invar face type, 3½ yd. in length, graduated in yards. With this type of rod the fine graduations are carried on a ribbon of invar metal, hence the errors due to change in length of the rods are negligible. Other equipment included a large umbrella for protecting the instrument from direct sun exposure, a portable wind shield and steel turning points.

The significant features of the leveling procedure used on this were as follows: Three cross-wire readings were made, without target, and the mean of the three taken as the middle wire reading. This computed reading was compared with the middle wire reading and known to be satisfactory before the instrument was disturbed. All leveling was double-run, each section of any line between adjacent bench marks being leveled over once in the forward direction and once in the backward. The readings of the cross-wires were observed when the level bubble was at the exact center, this being made possible by an optical arrangement which permitted the observer to read the bubble position with the left eye and then by shifting the attention to the right eye to read the three cross-wires. The lengths of backsight and foresight readings were balanced within 10 yd. on every station, or set-up of the instrument, and the totals of such distances for any section were not permitted to vary by more than 20 yd. To offset the effect of settling of the instrument, the backsight was read first upon one set-up, and the foresight upon the next. The adjustment of the level bubble was tested at intervals of not more than two days, a modification of the two peg method being used and correction made if an error of more than one division was discovered. The two runnings, in opposite directions, of any section had to agree within 0.017 foot $\sqrt{M}$, "M" being the length of the section in miles. The mean of these two acceptable runnings was used as the field difference of elevation between the two bench marks.

Level balancing

Upon completion of the field work the field differences of elevation were computed for each circuit, and circuit closures calculated. These closures were then adjusted, or balanced, by the method of least squares. In this method of adjustment each circuit represented a condition equation in which the unknown quantities to be determined were small corrections to the field differences of elevation for the sides of the polygons (or circuits). Since the original level survey included 13 circuits having 36 polygon sides, the least squares adjustment similarly comprised 13 condition equations with 36 unknown quantities. The corrections to the field differences of elevation resulting from the solution of these equations were then applied to each polygon side, being distributed to the various sections comprising each side in proportion to the length of the sections. Elevations for all of the bench marks were then computed by adding or subtracting the corrected differences of elevation to the starting elevation at the old City Bench Mark No. 0.

These adjusted circuits formed the basis of the growing bench mark system for the entire district. As the opportunity or need has arisen these basic circuits have been sub-divided, and the total length of precise levels run to date probably exceeds 200 miles. The bench mark data are kept in a manner similar to the traverse data, that is by means of a key map and a card file.

Topographic mapping

The topographic maps compiled with the aid of the survey data are being made on a scale of one inch equals 200 ft. with 2 and 1 ft. contour intervals, that is, 2 ft. contours are shown throughout but where the slope between these contours is not regular, the one foot contour is added but shown in dotted lines.

The boundaries of all sheets are true north and south, and east and west, in order that azimuth or bearings of any line may be quickly scaled from the map. Each map sheet covers one minute of longitude and 35 seconds of latitude. For convenience in plotting the sheets the geographic coordinates of each sheet corner were converted to rectangular coordinates and from these the dimensions of each sheet figured. Each sheet is slightly narrower across the top than across the bottom since the sheet sides are on meridians. The formulas and arc lengths used in converting geographic to plane coordinates were taken from *Special Publication 71* of the U. S. Coast and Geodetic Survey.

The plane table method of taking topography was used in this work. It is generally conceded that this is superior to other methods because a more accurate delineation of the surface of the ground is secured when contours are sketched while the party is in the field. The maps used on the plane-table board are of heavy white drawing paper permanently mounted on 18 gage aluminum. These metal mounted sheets eliminate the expansion or distortion which occurs when ordinary muslin-mounted sheets are exposed to the weather.

The sheets are laid out in the office with geographic boundaries, 1,000 ft. rectangular coordinate lines, traverse points and bench marks shown. For ease in indexing and to avoid confusion resulting from mapping in various locations, the sheets are numbered spirally in a clockwise direction, and sheet No. 1 contains the coordinate origin. This system permits of infinite expansion with all sheet numbers selected in advance. The total progress to date in field mapping is 8,500 acres, comprising 9 complete sheets and 31 fractional parts of sheets.

These completed sheets are being reproduced in four colors by engraving on glass negatives. All engraving work is being done by members of the force on engravers tables which were designed and built by the department. The photography and press work is done outside.

The specifications describing the equipment, methods and accuracy of results under which the triangulation and all other divisions of the surveys were executed, were adapted from the preliminary draft of the *Manual on City Surveys*, prepared by a committee on technical procedure for city surveys of the Am. Soc. C. E.

Administration

Roscoe N. Clark is city engineer of the City of Hartford, Robert J. Ross is assistant city engineer, the writer, as division engineer is in direct charge of this work. The R. H. Randall Co., of Toledo, Ohio, were retained as consultants during the early portion of the work.

Modern Brick Paving Practice

A resumé of method and procedure that has been developed by research and standardized by practice, emphasizing stabilized subgrades, smooth bases, thin cushions, de-aired brick and bituminous fillers.

By Roy L. Phillips
City Engineer, Meadville, Pa.

BRICK as a paving material has been used and abused since the early days of our recorded history. Roads built in Holland during Napoleon's time are still under traffic. The first brick pavement on this continent was built in 1871 and brick has been widely used since that time under varying traffic conditions. Early pavements were laid to "get us out of the mud" and block pavements of all kinds were laid directly on the subgrade or on a gravel base and sand filled. While many of these pavements gave good service, others became rough under increasing loads and frost action. Construction showed little effort to provide properly shaped and drained subgrades, and bases were not uniform in thickness or smooth on top. The use of two or more inches of sand cushion was common and 4-in. repressed brick was the most popular type of the more than sixty sizes and types manufactured. Sand, sand-cement grout or tar were the popular fillers and high crowns were the rule. High curbs and crosswalks at grade were popular.

Our standards have changed and today the pavements which we design and build must not only remain smooth after years of service but must also maintain a clean, skid-resisting surface under a variety of weather conditions. Modern laboratory and test road research work combined with the intelligent and honest efforts put forth by paving engineers and material manufacturers has developed a fine type of brick pavement. The following discussion will be devoted to a resumé of the details of modern practice.

Subgrade and base course

A good subgrade is needed under any type of pavement and modern soil stabilization methods present the most recent contribution to this cause. We will see great development in this field in the next few years.

Base course design and construction are still highly controversial and many materials are being used successfully. Worn concrete, bituminous macadam or old brick streets or roads are being left in place for foundation use. The surface is smoothed, if necessary, with a mortar coat or bituminous concrete and the result is an excellent base which has great supporting strength. Natural sand, slag, crushed stone, gravel or Florida lime rock are used in different parts of the country but such materials are usually a concession to first cost and are not used where permanent smoothness is essential.

Lean concrete is generally accepted as the best known base and is laid from 5 to 10 in. in thickness to meet varying traffic conditions. Reinforcement or additional depth is used where needed to provide proper load-bearing capacity. Rich mixes are still used by some state highway departments but are rarely found in city work. The lower coefficient of expansion and contraction found in the lean mixes is desirable as it results in only hair line temperature cracks which do not permit the loss of bed material with resulting brick settlement.

The use of a 1:3:6 mix or its equivalent in water cement ratio, built of a thickness to meet anticipated traffic conditions, will give excellent results. This type of base does not need expansion or contraction joints but if richer mixes are used, the cracks in the base should be controlled by the use of contraction joints at intervals of not more than 40 ft. Such joints should be covered to prevent the loss of bed material, and planes of weakness should be established through to the surface of the brick. Increasing stress is laid on the necessity of a smooth and dense foundation surface, shaped to final templet form with the same templet that is used to shape the bed material. Carelessness at this point will prevent the use of a uniformly thin bed for the brick and eventually will result in a rough pavement surface. A good modern pavement must be smooth and should ride well.

Bed construction

Plain sand, slag sand and a mixture of cement and sand are all used as bed material but are subject to weaknesses under various conditions. The modern thin cushion having a maximum thickness of $\frac{3}{4}$ in. (and preferably less than that) is more stable than the heavy ones of a few years ago. Slag sand with some setting qualities or a thin layer of coarse angular sand grains, having little tendency to flow, will frequently give a smooth serviceable pavement over a period of years but these materials both flow at times under heavy traffic and a rough pavement follows. The rigidity of the cement-sand bed seems to prevent its use with soft brick fillers and it finds little place in modern design.

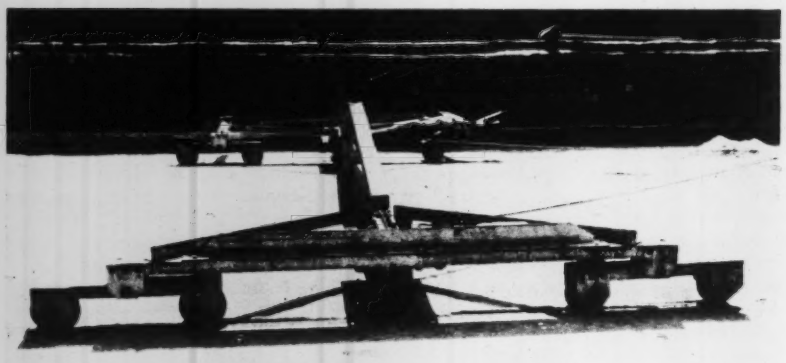
A study of bed materials clearly indicates a mastic of sand and either tar or cut-back asphalt. This material seems to have all the desired qualities. It is flexible, stable under traffic, allows free movement of the brick surface under stresses due to temperature change and is easily handled on the job. The grade of bitumen to be used will vary somewhat with the atmospheric temperature and the characteristics of the sand. The sand must be dry and should be machine mixed with the bitumen in proportions which will give a finished material which is easily spread and readily compacted and which will retain its stability during the rolling of the brick and thereafter during the life of the remainder of the pavement. Various proportions have been tried at different times.

Proper mix proportions

Prof. John S. Crandell, University of Illinois, who is credited with originating this type of cushion in 1912, states that 7 per cent of bitumen gives the best results. Very much less than this results in no bitumen after a period of years and more gives a sloppy mix which cannot be worked. Experimental work is being carried on with bituminous concrete mixes having some crack bridging qualities, but no results are yet available.

The shaping of the bed is of great importance as this operation controls the contour of the finished brick surface. Curbs, gutters or other guides for templets must be built accurately and the templet itself should be rigid, correct as to shape and be of a compensating type, which will reduce to a minimum, all irregularities in the finished pavement. The latest specifications of the American Society of Municipal Engineers describes a templet of this type which is pictured here. This templet, originally developed by an Ohio contractor and a member of the staff of the Metropolitan Paving Brick Co. is now a requirement on all state highway department work in Ohio. Rollers are used on curbs and disk wheels on the finished concrete base.

BITUMINOUS MASTIC for cushion purposes is easily handled and if properly mixed and compacted will retain its stability for the life of the pavement.



COMPENSATING STRIKEOFF TEMPLET for brick cushions is required by Ohio state highway department. It has a metal cutting edge supported by a truss.

SURPLUS ASPHALT FILLER can be removed with straight hoes or sharp spades if the brick is first coated with lime whitewash. The value of the salvaged material offsets the cost of removal.

Rolling of present day thin beds is often omitted. The material should be deposited on the base so that it will be rehandled in placing. Uniform compaction under the brick roller is assured. This technique shows no appreciable amount of bed material rising in the unfilled joints on rolling of the brick or any increase in the areas which do not meet the straight-edge requirements for smoothness. Rolling is still insisted on by some engineers and certainly it does no harm.

Brick sizes and types have been reduced from more than sixty which were manufactured only a few years ago to four standard types today. The accepted sizes and types are shown in the accompanying table.

STANDARD SIZES AND TYPES OF PAVING BRICK

Type	Size in Inches		
	Depth	Width	Length
Repressed lug	4	3½	8½
Vertical fiber lug ..	2½	4	8½
Vertical fiber lug ..	3	4	8½
Vertical fiber lug ..	3½	4	8½

The list has been arrived at by eliminating those sizes or types which fall below 5 per cent of the total shipments during the previous year. The vertical-fiber lug brick is the heavy favorite. More than two-thirds of all brick shipped are of that type. This brick furnishes a skid-resisting wire-cut road surface and the small lug and square edge give a uniform ⅛-in. joint for filler admission with the resulting well-filled and well-supported joint which has given most favorable results on all road tests. Repeated tests have shown the superiority of the 3-in. vertical fiber brick over the 4-in. repressed with its beveled joints and have also shown the necessity for a square-edged brick with the smallest spacing that will properly admit the filler. Lugs are provided on one side and both ends and the end lugs must not interlock. Lugs must not in any case be continuous from top to bottom of the brick as nothing should interfere with a free horizontal flow of the filler. The writer is of the opinion that there is no justification for the manufacture of anything other than the vertical-fiber lug brick in various depths and believes that designing engineers should cooperate with the Standardization Committee and the manufacturers by specifying only this type.

Quality of de-aired brick

The de-airing process of brick manufacture is being used today. A more dense brick is indicated by a weight increase of 4 per cent and lower rattler losses. Bricks are being produced which give an absorption of less than 1 per cent, a minimum of laminations and the crushing strength of good granite. Some difficulty has been experienced in controlling this process but at its poorest the product is equal to those previously used. Many such brick are under traffic today and extensive research on this process is being carried on by the Brick Committee (C3) of the American Society of Testing Materials and by the U. S. Bureau of Public Roads.

Methods of laying and rolling brick have not changed materially. Insistence on smoothness is essential and lower tolerance of deviation from a 10-ft.

BRICK PAVEMENT at entrance to Holland Tunnel has slate-filled mastic filler that has gone through two summers without exuding.

straight edge are common practice. The uniform thickness of the vertical-fiber brick and careful workmanship make this possible.

Where rich concrete bases are used it is good practice to establish a plane of weakness in the brick surface by inserting building paper or similar material between the brick in the transverse joint lying over contraction joints in the base. This requirement concentrates the cracks resulting from base contraction in one joint. A regular premoulded or poured joint is used for expansion and contraction where grout filler is used.

Fillers and filling

Whenever paving engineers get together brick fillers are good for a discussion any time. Down through the years, sand, cement grout, tar, asphalt and various mastics have been tried. The story is told of the city engineer in rough country who still uses sand filler because after every hard storm he hauls all his brick pavement surfaces back up the hill and relays them—the sand cleans off easier.

Good pavements are found having all the above fillers but on at least 95 per cent of all new brick pavement at the present time asphalt or asphalt mastics are used as fillers. Experiments with sulphur and other materials are being carried on but no such material has passed the experimental stage. Very little mastic filler is being laid on account of the difficulties of preparation and application. Segregation of the mineral matter from the asphalt has been one of the outstanding difficulties with this type in the past. A mastic is now being produced commercially with a ground slate mineral filler and those who have used it claim that all the old weaknesses have been eliminated.

A straight asphalt provides ample support for the close, square joint of today and effectively seals the pavement surface. The question of hard or soft asphalt is still being discussed but a 30-40 penetration asphalt meeting the specifications of the American Society of Municipal Engineers seems to be the best answer. This type of material is specified by most states and cities today.

A vertical-fiber brick road, free of asphalt filler on the surface has a high coefficient of rolling or sliding friction. Surplus filler, left from construction or acquired later, substantially reduces this highly desirable friction which is so necessary for safe driving. Good practice today demands the removal of surplus filler from the surface of the brick after filling. This is made easy by coating the top of the brick with lime whitewash, mixed in the proportions of 1½ sacks of lime to 50 gal. of water, or a solution of calcium chloride, composed by weight of 35 per cent calcium chloride, 1 per cent laundry starch and 64 per cent water. Either of these materials is applied with a hand brush or a pump and spray nozzle.

Surplus filler reclaimed

Care must be taken that none of the separating material enters the joints. The filler, heated to 400 deg. F. is slushed on with buckets, allowed to cool and cut off in strips with sharp spades or straight hoes. The removed material is returned to the kettle to be heated over. The salvaged asphalt offsets the cost of removal and the result is a clean brick surface with well filled joints when the construction is completed. A proper coordination of time elapsing during the application of the separating agent, the application of the filler and its removal, will simplify this entire operation.

Unfortunately bleeding or exuding of the asphalt from the joints after a period of years sometimes results in a slippery surface. The use of a low penetration asphalt, heated to the high temperature of application noted above, tends to minimize this trouble which is not at all universal. Mastic fillers are very stable, have lower coefficients of expansion and generally do not exude. The engineer who has had exuding trouble eagerly watches the performance of mastics.

Relaying and resurfacing

We have already stated that many of the original brick pavements were laid on inadequate bases, heavy sand cushions which have shifted or directly on the native soil. The various work relief programs have given great stimulus to the relaying of many miles of this kind of street pavement as the work involves a maximum of hand labor. Bricks have been lifted, cleaned, turned and relaid with a new filler. In some places new bases have been laid and in others, the old cushion has been reshaped and the brick relaid.

Relaying procedure has become standard practice and is wide-spread wherever brick pavements are found. The salvage records of the old surface runs from 75 per cent in the Pittsburgh district to 92 per cent on fifty streets relaid in Toledo, Ohio. In some cases brick which were originally laid on edge have been laid on their sides and a surplus hauled off the street on the completion of the work.

Resurfacing with new brick is being done over every kind of old pavement as a base. In some cases the old pavement is brought to the templet form of the new pavement by cement concrete or bituminous patches. In extreme cases, several inches of new material may be added to the top of the old pavement to get a smooth base. Old pavements which have become rough on the surface make the finest bases when smoothed this way. A thin bituminous mastic cushion is then applied and new paving practice followed for the remainder of the work. New curbs are frequently added to the sides of old pavements to retain the bed and the brick and incidentally to provide additional road width.

Conclusion

The brick pavement in most popular use today consists of a 6-in. 1:3:6 concrete base; ¾ in. of bituminous mastic cushion; 3 in. thick vertical-fiber lug brick with small lugs on one side and both ends and a 30-40 penetration asphalt filler which is in the joints and not on the surface of the brick. The thickness of the base will vary from 5 to 10 in. and the brick from 2½ to 3½ in. depending on the traffic load expected and the individual ideas of the designer. Other features should be constant.

Considerable deviation from the above design will be found in isolated cases but there is little excuse for departure from standards which have proven themselves, particularly when no real advantage is to be gained.

Buffalo Solves Its Sewage Problem

Low-level intercepters to divert dry weather flow to Bird Island where sedimentation and chlorination will be provided—Digestion and incineration processes are under study for sludge disposal

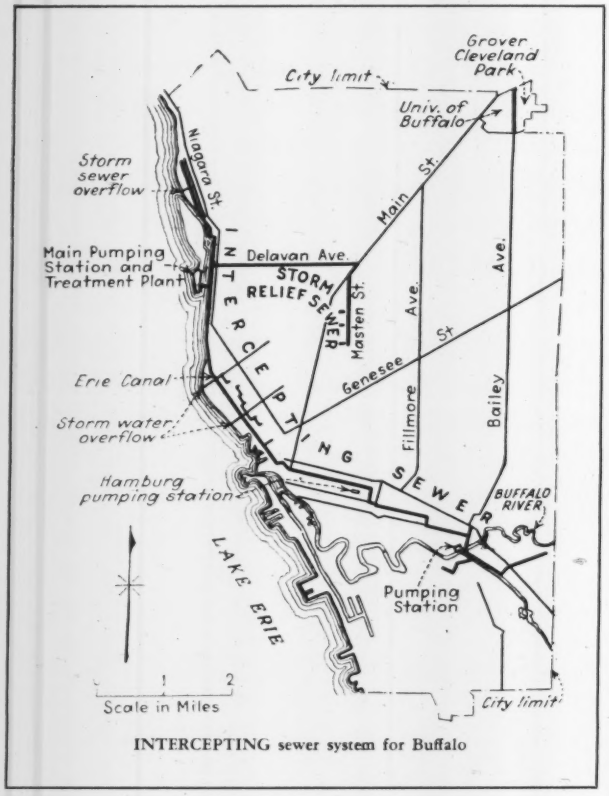
WITH CONTRACTS for intercepters under way and plans nearly ready for an early fall letting of the treatment plant contracts, the Buffalo sewage problem is well along towards solution. Objectives sought are to relieve the Buffalo River and the lake harbor from excessive pollution and to reduce the pollution and bacterial content of the Niagara River, to lessen the load on water treatment plants downstream. Methods for obtaining these objectives include (1) diversion of sewage from the river and harbor by intercepting the dry weather flow and a portion of the early storm flows, (2) treatment to remove suspended and floating solids and to effect a satisfactory bacterial removal and (3) proper dispersion of the plant effluent into the Niagara River. This article gives the basic data on which the designs for the various structures were predicated and includes a general statement of the treatment plant features.

Various structures in the work are designed for different lengths of life. Expensive structures that cannot readily be enlarged, such as the intercepting sewer, are built for relatively long periods; in this case, for 50 years hence or the year 1985. Structural features of the pumping station which cannot readily be expanded are built for the requirements of a 45- to 50-year period in the future, and pumping equipment is predicated on the capacity of the intercepting sewer. Those parts of the treatment works that can easily be enlarged will be built to cover the needs for the next 15 years.

The necessary basic data that were assembled for the design included information on population growth and distribution, drainage areas, rainfall and runoff, sewage quantities and characteristics, volume and character of industrial wastes and the regimen of streams and waterways which will receive the sewage overflows and treatment plant effluent.

Population was studied on the basis of past census reports as well as by comparison of growth in other similar cities. In working out the population of the different sewer districts, a factor of safety was introduced to provide for any abnormal development of an individual district. The sum of the districts' population for 1985 is therefore greater than the estimated 1985 population for the whole city. The latter is 1,100,000 people and the intercepting sewers are designed to care for that number. The population in 1950 is estimated at 750,000, the basis of design for the treatment works.

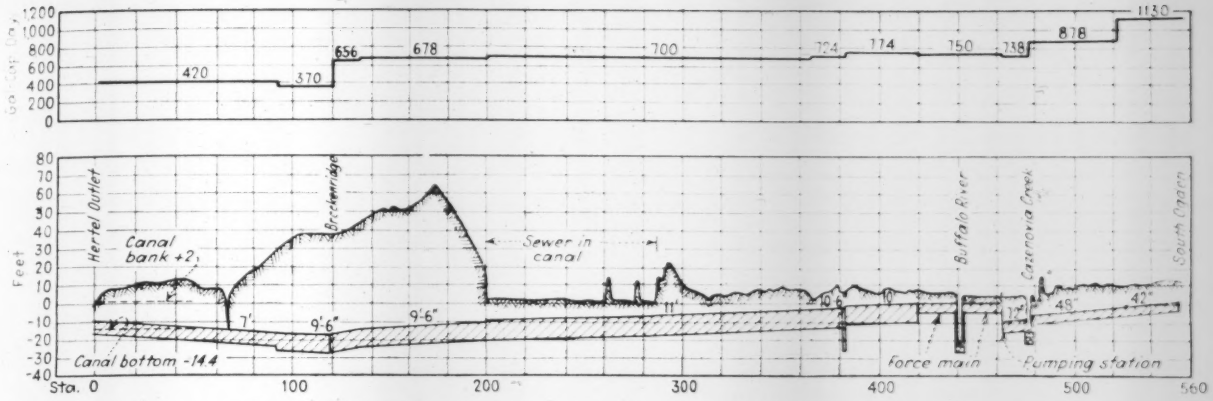
Based on the study of available information relative to the quantity of sewage, it was assumed that the average annual rate was 200 gal. per capita per day for the whole city, and for 1950 when the population will be 750,000, the total average flow is equivalent to 150 m.g.d. The capacity of the intercepting sewers at the point of discharge will be 560 m.g.d. This capacity will care for three times the dry weather flow for the section of the intercepting sewer paralleling the Buffalo River and for 2½ times the dry weather flow for the section along the harbor front. The maximum size of sewer is equivalent to a circle with a radius of 13 ft.



INTERCEPTING sewer system for Buffalo

Characteristics of Buffalo sewage were determined from extensive records of sewer analyses of other cities and from analyses made in 1929 by the Buffalo division of engineering. These data indicated that suspended solids at present are equivalent to 0.3 lb. per capita per day, or 180 p.p.m. based on the dry weather flow, and that the B. coli content is about 46,000 c.c. The B.O.D. is estimated at 170 p.p.m., equivalent to 0.28 lb. per capita per day. Subsequent analyses have indicated that the above figure of 0.3 lb. per capita per day of suspended solids is rather high and a lower figure may be used. Compared with sewage from other cities that of Buffalo may be characterized as rather strong, and in volume, somewhat greater than the average. It is influenced by industrial waste, the exact nature of which is yet to be determined by tests.

The Buffalo River has a small natural flow in the summer time which is discharged into an estuary created for navigation purposes by dredging. The river has a volume of about 165,000,000 cu.ft. and a surface area of 8,400,000 sq.ft. below Cazenovia Creek. Many sewers now discharge into it, and some larger sewers intercepted by the Swan St. intercepting sewer frequently overflow into it. All of this sewage ultimately will go



PROFILE of intercepter showing the increased per capita capacities at the upper end of the sewer.

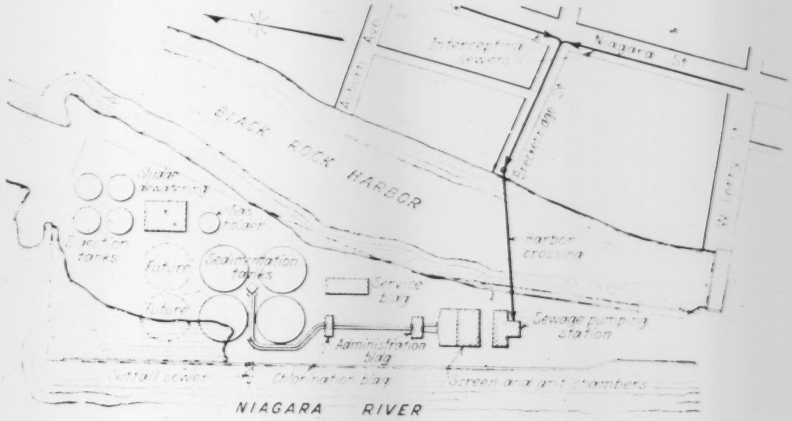
to the treatment plant excepting such volumes of industrial waste and sewage as are discharged directly into the river during storms. However, reasonable capacity has been provided for receiving all dry weather flow and industrial wastes. The evidence indicates that the diversion of three times the average dry weather flow of sewage and water will maintain the Buffalo River in an inoffensive and otherwise satisfactory condition. Studies indicate that this diversion will maintain a residual dissolved oxygen content in the river in excess of 4 p.p.m. during periods of low river flow in a dry year. This amount of dissolved oxygen, it is held, will prevent nuisance in the river.

The harbor wastes are confined by government breakwaters and embankments. Wind action creates the principal movement, although lake seiches (an oscillation of the surface believed to be initiated by atmospheric changes) have some influence. There is little or no direct discharge of sewage south of the mouth of the Buffalo River and within the city of Buffalo. However, some discharge of industrial waste within and without the present city limits may produce an unsightly appearance and affect the quality of city water under unusual conditions. In 1928 phenol tastes from gas works and coke oven byproducts plants were experienced in the city water. The industries now recover these phenols and keep the contamination out of the river and harbors.

Excess stormwater is discharged into the old channel of the Erie Canal. These discharges find their way to the canal and into Black Rock harbor which latter is also heavily polluted by a number of sewers. The flow in Black Rock harbor is determined by the volume of water that passes the government locks, either entering the Niagara River or into the old channel of the Erie Canal below the locks.

It was concluded that if 2½ times the dry weather flow of sewage is diverted from the harbor and if in addition some flow is provided around the government locks at the lower end of Black Rock harbor, probably not in excess of several hundred second-feet, the condition of the harbor would be rendered satisfactory.

Pollution entering Niagara River does not create a marked nuisance but at times the stream near the United States shore is colored markedly for 100 ft. or more from the shoreline and for a number of miles below Buffalo. The load of pollution creates a burden on water purification plants below. The flow in the river



TENTATIVE ARRANGEMENT of Buffalo sewage plant on Bird Island.

BULKHEAD across Erie Canal, and temporary pumping plant for unwatering at right.

is upward of 200,000 sec.-ft., and the problem is to remove the unsightly appearance of the water and reduce the bacterial content.

Intercepting sewer locations

In studying alternate locations for the intercepting sewer it was found that there would be no great economy in attempting a high level interception for the purpose of saving pumping costs. The Buffalo intercepter follows in a general way the course of the lower portion of Cazenovia Creek and the Buffalo River valley below the junction of Cazenovia Creek to the Lake Erie waterfront, extending northward along the Niagara River to the site of the sewage treatment works on Bird Island. Another intercepter has its upper end in the northern part of the city adjoining the Niagara River, extending southward to meet the main intercepting sewer at a point where the flow of both of the intercepters will be pumped into the treatment plant. The main intercepter, force main and South Buffalo intercepters are shown in profile together with capacities. The enlarged per capita capacity at the upper end is to take care of the larger relative runoff from the smaller areas.

The central section extends from Porter Ave. to Commercial St. and is being built in the Erie Canal, the latter having been dewatered for this purpose. It was considered more economical to put the intercepter in the canal and dewater it rather than to excavate the towpath along the side.

In the South Buffalo section a pumping station is required. This is also true of the Hamburg district, where there is now a station which will be rehabilitated. Consideration was given to the extent of pumping lift which as an economic relation to intercepting sewers in establishing the least total annual cost. If the sewers are made steeper in slope they can be made smaller in size but this increases the pumping lift; a satisfactory balance was eventually worked out. Whether it will be feasible to digest sludge and utilize the gas thus obtained for pump operation has not yet been determined.

Plans for sewage treatment

The extent of sewage treatment required and indicated by the findings of the International Joint Commission on Pollution of Boundary Waters calls for a mean annual cross sectional average of B. coli not exceeding 500 per 100 c.c. The Commission further stated that the necessary sewage purification can be effected by fine screening or sedimentation and when necessary by chemical disinfection.

The plans as worked out include a main pumping station, trash rack, grit chambers, large aerated conduits, plain sedimentation tanks, and mechanical devices for dewatering and incinerating sludge. As an alternative the sludge may first be digested and then dewatered. In this case dewatered sludge may be incinerated, used as a fertilizer or deposited in dry fill.

UNWATERED ERIE CANAL bed in the bottom of which an 11½ ft. semi-elliptical intercepting sewer will be built.

The main sewage pumping station and treatment plant are located on Bird Island opposite Breckenridge St. and the intercepters terminate at the west end of Breckenridge St. and Black Rock harbor, with invert elevation at —28.59. From the land terminal there is a submerged crossing under Black Rock harbor. Some consideration was given to locating the pumping station on the mainland but it was finally decided that sufficient velocities in the harbor crossing and easy access to the submerged conduits could be provided to obviate any difficulties caused by deposition of grit. The advantage from an operating point of view in having the pumping station adjacent to the treatment plant was a factor in deciding on the location on the island.

The general plan of the treatment plant with round sedimentation tanks is shown in Fig. 2. Rectangular tanks are proposed as an alternate. As much of the plant as possible is located on ground above water; future additions will be place on filled ground to be made in open water which will have time to settle before it is required. In consequence space for future extensions is located in part offshore of the northern part of the island.

A few of the controlling elements of the design are as follows: Sedimentation tanks are to provide a displacement period of 1 hr. 20 min. The average rate of sewage flow is 150 m.g.d. This is equivalent to 21 min. displacement at the maximum rate of sewage flow of 563 m.g.d. It has been decided to prechlorinate the sewage: the chlorination contact time will be from 21 to 80 min.

Controlling elevations are as follows: Sewage surface in grit chambers: aver. —0.60, max. 2.85, min. —0.80. Effluent weirs in sedimentation tank —1.25; sewage surface in sedimentation tanks, aver. —1.10, max. —0.85, min. —1.15; water surface in Niagara River, aver. —7.6, max. 0.75, min. —9.8.

Normal high water in Niagara River is El. —5.7. The river will be at or below this elevation 99 per cent of the time. It is estimated that a maximum of 0.75 is not likely to occur but once in one thousand years. From existing records the controlling maximum is more nearly—2.0. These maxima are due to seiches.

The freeboard provided in the sedimentation tanks has been established at 3 in. with maixmum computed river level 0.75. This means that with a river level of 0.75 there will be no flow of sewage through the treatment plant.

Sub-soil explorations of the site made by eight test pits and several borings indicate that rock is at —45.0, above which is a layer of varying depth of gravel, sand and clay covered by mixed fill. The lowest structure is the main pumping station which will have an inside surface of the lowest part at El. —31.5.

No piles are considered necessary under the pumping station but it has been considered advisable to place piles under the footings of bearing walls.

Main pumping station details

A variety of different types of pumping units were investigated and vertical shaft pumps with close-coupled motors were decided upon as the most economical equipment at the main pumping station. Sewage will flow from the riser shaft at the west end of the harbor crossing, through coarse trash racks with bars spaced 5½ in. in the clear, through gate chambers into a suction well located below the pump room floor. The gates

provide for shutting off and isolating either half of the pumping station. Six identical pumping units, each having a capacity of 95 m.g.d. at a head of 25 ft., are provided. Each pumping unit discharges into its own screen and grit chamber independent of the other pumping units.

The purpose of the screens is to remove coarse suspended solids and heavier grit-like solids. Each grit chamber comprises two flowing-through channels. The screens, of the heavy bar type with clear openings of ¾ in., will be automatically cleaned with moving scrapers which will deliver the screenings into grinders. The ground screenings will be returned to the sewage to be removed in the sedimentation tanks as sludge. Each grit chamber will be 65 ft. long and fitted with mechanical equipment for collecting, elevating and washing grit, which is to be delivered to bins, and from there into trucks. As each double grit channel will pass the sewage delivered by one pump only, the velocity through the grit channels will depend upon the elevation of the water surface and the hydraulic losses through the succeeding structures of the treatment plant. The velocities through the grit chambers will be between 0.5 and 1.1 ft. per second.

Covered aerated conduits

Leading to the sedimentation tanks are aerated conduits, 9 ft. wide, having an average sewage depth of 8 ft. As the velocities will not be sufficiently high to prevent deposits at times of normal rates of flow the sewage will be agitated by air to prevent objectionable deposits and to drive off some of the entrained gases. In consequence, conduits will be covered as a measure of odor control. Scum rising to the surface during this agitation will be removed mechanically in the sedimentation tanks. Conduits will be aerated by a system of perforated pipes so that the air required for agitation can be recirculated and only a relatively small portion removed for discharge through a ventilation tower. The wasted air may be cleaned before it is discharged into the atmosphere.

Other odor control devices

It is proposed to cover all conduits, shafts and structures as far as the inlet end of the sedimentation tanks and to remove from them the enclosed air, together with any gases which may escape from or be blown from the sewage. All of this air will be delivered to a ventilating tower, or to some other place for disposal with provisions included, at least for future installation, for air-cleaning devices, such as washing with water, burning at high temperature or chlorinating. Also considered is the possibility of pumping this air through a submerged pipe into the Niagara River.

Located over the main sewage conduits close to the sedimentation tanks is the chlorine building. This provision has been made in order to prechlorinate the sewage prior to its entry into the sedimentation tanks. Consideration has been given to the relative merits of partial chlorination along the intercepting sewer. At the treatment plant adequate capacity is provided for full chlorination. Average requirements are for chlorine at the rate of 30 lb. per m.g. during periods of maximum sewage flow, with a capacity of 10 tons of liquid chlorine per day. The average annual rate is estimated at 60 lb. per m.g. or 4½ tons per day. Mixing of the chlorine will be accomplished mechanically in the conduits prior to discharge of the sedimentation tanks.

Sedimentation tanks

The sedimentation tanks have been estimated to remove 50 per cent of the total solids. If the round type is chosen there are to be four units, each 160 ft. in diameter, with side liquid depth of 14½ ft. If rectangular tanks are used there will be four units, each 200 ft. long and each having six compartments equipped with mechanism for removing sludge.

Final conclusions have not yet been reached but it seems likely now that final disposal of the sludge will be by incineration after mechanical dewatering, but whether it will be first digested has not yet been decided.

The main outfall structure will be built in the bottom of the Niagara River, the exact location to be determined by studies of currents by floats and dyes.

Personnel

The Buffalo intercepting sewer and pumping station project is being handled by the Buffalo Sewer Authority, a board authorized by the state legislature to eliminate pollution from the Niagara River, Lake Erie and the Buffalo River. Greeley and Hansen are engineers for the Authority and have established an office at the City Hall, Buffalo. The engineering staff includes C. R. Velzy, resident engineer, Neil C. Holdredge, construction engineer, John H. Gregory, consultant, with Messrs. Paul E. Langdon, T. M. Niles, L. G. Williams, S. M. Clarke, and A. T. Jensen in charge of special phases of the investigations, design and the construction. Dr. G. E. Symons is head of the laboratory, Mr. Edward P. Lupfer is directing engineer for the Authority, and Mr. Harold Epstein is project engineer for PWA.

The work is financed by a PWA grant and loan in the total amount of $15,000,000 on the 45-55 per cent basis. Up to Sept. 1 contracts had been let covering more than $7,000,000 of construction.

Tin Cans from City Incinerator Furnish Foundation for Street Pavement

THE USE of burned tin cans as a foundation for surfacing dirt streets is a novel method adopted by W. H. Weaver, city engineer of Decatur, Ga. for disposing of part of his municipal incinerator refuse. Although it is not claimed that this material is the ideal street pavement, a good wearable surface is produced and what is more important, the problem of incinerator ash disposition has been solved.

The city of Decatur has been operating a garbage incinerator since 1926 with a capacity of 16 tons per day, designed to turn 5 per cent of this amount in tin cans. Due to the fact that either there has been a great increase in the amount of canned food consumption or that Decatur residents use more than the average amount of such food, there has been a much higher percentage of discarded tin containers reaching the incinerator than was originally contemplated. It was with the idea of economically disposing of this excess burned material that first caused Mr. Weaver to use it on dirt streets in the poorer sections of the city as a surface medium, to eliminate muddy conditions during rainy weather.

"Tin-canning" procedure

The method of construction of a "tin-can" pavement is as follows: The dirt street is first carefully bladed with a road grader to leave a shoulder of about 6 in. thickness on the edge of the street. Burned tin cans, hauled from a storage pile in the rear of the incinerator, are dumped along the street to a depth of from 18 to 20 inches. They are then thoroughly rolled, crushed and compacted after which a covering of coarse sand or top soil is applied. This latter is thin enough to permit easy access of rain water and air so that the metal under the surface will quickly oxidize.

At the end of six months to a year the oxidized tin can has been converted to pure rust which acts as a ferruginous binder. The surface remains extremely hard in both wet and dry weather and can be cheaply maintained by light blading at intervals.

Improved Sewerage System and Disposal Plant at El Paso

Existing collection system extended to cover 90 per cent of developed city and interceptor constructed to eliminate pumping 40 per cent of sewage—Treatment plant revamped to meet present requirements and all old structures salvaged

By H. G. Stacy and F. M. Veatch
Respectively, City Engineer, El Paso, Tex., and member of Black & Veatch, Kansas City, Mo.

EXTENSION and betterment of the sewage disposal facilities of El Paso, Tex., involving additions to the collection system so that more than 90 per cent of the laid out portion of the city is covered, and the construction of an interceptor which relieves overloaded mains in the lower part of the city and thereby eliminates pumping 40 per cent of the sewage, were completed in March. In addition, the old septic tank disposal plant, built in 1922, has been modernized by the installation of a mechanical shredder screen and drag-type grit chambers ahead of a combined pre-aerator and mixer at the entrance of which chemicals are applied. In the three old tanks settling basins with straight-line flight sludge collectors were built. Of nine of the fifteen remaining tanks converted into digestors three are covered to permit recovery of gas.

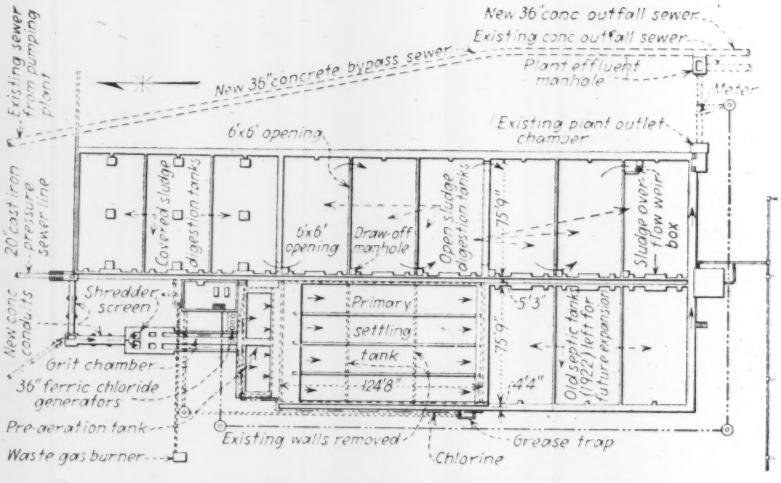
El Paso which has a population of 105,000 is located on the Rio Grande immediately below the celebrated "Paso Del Norte" through which the bulk of the travel to and from Mexico has passed for centuries. The business and industrial sections of the city are located in the immediate river valley and the street surfaces in these sections which parallel the river in a general way are at or very near the elevation of the river bed. This section of the city is protected by a levee which has been adequate since the river flow has been controlled by the operation of the Elephant Butte reservoir. Previously destructive floods were prevalent.

Surface drainage is pumped into the river channel. The residential district lies to the north of the business and industrial sections and ranges in elevation from 3,700 to 4,200 ft.

Existing sanitary facilities

The sanitary sewer system which has been developed piece-meal during the past 40 years is laid out with the collecting mains running parallel to the river and terminating in a sump at the lower end of the city from which the sewage is pumped through the disposal plant to the river. Storm drainage has been excluded, as far as possible, from the sanitary sewers.

Sewage disposal was first practiced in 1910 when a plant which included



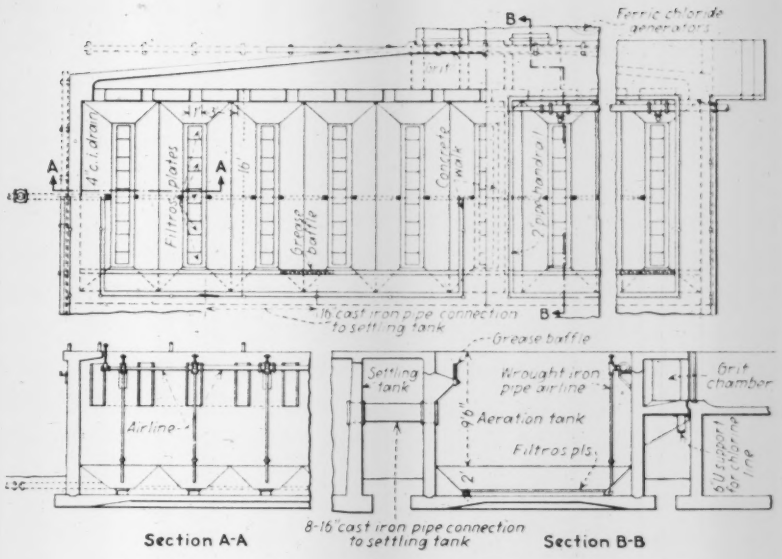
EL PASO'S EXISTING DISPOSAL PLANT has been converted into a new plant with primary settling tanks located in one set of three old septic tanks and the digestion tanks in nine of the old tanks.

OLD SEPTIC TANKS have been converted into digestion tanks, three of which are covered to permit gas recovery.

screens, septic tank and sprinkling filters was constructed near the existing sewage pumping station at Martinez St. This plant, never very successful, was abandoned in 1922 when a battery of fifteen septic tanks was constructed at a more isolated site nearer the river. A pumping plant, screen chamber and a 36-in. concrete discharge line to the new plant were built at that time and are still in service. During the period from 1922 to 1925 the population of El Paso increased from 80,000 to 105,000 and naturally this growth was reflected in increased sewage flow. The main sewers in the lower part of the city became inadequate as to size although they are in fairly good structural condition and the disposal plant was overloaded to the extent that it became a nuisance.

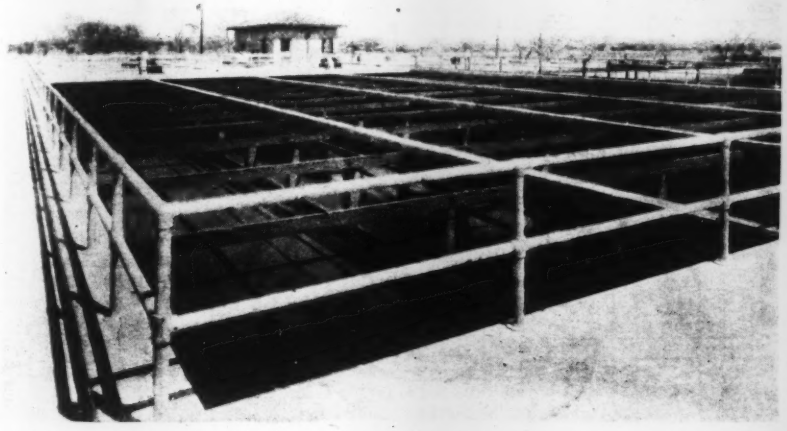
The improvement program which was started in 1934 and constructed during 1935 and 1936 includes the following main features: (1) The relief of the existing main sewers and pumping station by intercepting the sewage from the higher part of the city and delivering it to the disposal works by gravity. (2) The extension of the existing system by the construction of laterals in various parts of the city. (3) Service to the Val Verde district which includes developed property in the eastern part of the city where the surface elevation is too low to permit gravity flow to the disposal works. (4) The remodeling of the existing septic tanks into a modern plant of the plain settling and sludge digestion type equipped for chemical precipitation. (5) The replacement of pumping equipment in the existing pumping station.

The intercepting sewer consists of a line of 15-, 18-, 21- and 24-in. pipe which starts in the western part of the city



PRE-AERATION TANKS serve also as mixers since ferric chloride is added at the entrance to these tanks.

STRAIGHT LINE SLUDGE COLLECTORS added to old settling basins drag sludge to trough at inlet end where cross flights bring it to a collection hopper from which it is pumped to the digestors in the far right.



at El. 3,739 and terminates in its eastern part at the entrance of an inverted siphon at El. 3,706. The sewage passes through a coarse bar screen having 2½-in. openings at this point and enters a siphon of 21-in. concrete pipe which carries it 7,000 ft. to the disposal plant. The sanitary sewage which originates north of this interceptor and which amounts to 40 per cent of the total flow is therefore carried to the plant by gravity and the existing sewers south of this line, as well as the main pumping station, are relieved to this extent.

Sewer lines up to 15 in. in diameter are of double-strength vitrified-clay pipe and those 18 in. in diameter and larger are of standard reinforced concrete pipe. The inverted siphon is constructed of 21-in. concrete pipe with side walls 5 in. thick. It is reinforced with 0.35 sq.in. of cold-drawn wire reinforcing steel, per lineal foot. The pipe was cast locally in 6-ft. lengths with slip joints moulded to accommodate an annular rubber gasket 1 in. in diameter. The maximum internal pressure in this siphon is 20 ft. and the specified leakage allowance of 200 gal. per day per inch of diameter per mile of sewage was more than met. About 25,000 ft. of 8-in. and 5,000 ft. of 10-in. lateral sewers were constructed as extensions to existing sewers in various parts of the city.

Because property lying south of Modera St. and east of Crockett St. cannot be served by the main system of sewers a new system, which terminates in a pump sump at El. 3,674, was constructed to serve this district. It includes 7,000 ft. of 15-in. double-strength vitrified-clay main and 22,000 ft. of 8-in. lateral sewer. The greater part of the 15-in. main sewer was laid in sandy soil with the normal groundwater level from 1 to 8 ft. above the invert. The ditches were dewatered by means of well points and pumps. Joints were made with jute and an asphaltic joint preparation. Leakage tests on this line showed 2,060 gal. per day per inch of diameter per mile of pipe.

The pumping station is equipped with two motor-driven, float-controlled sewage pumps of the non-clog type, each of which has a capacity of 300 gal. per minute. These pumps discharge through 1,300 ft. of 8-in. pipe to the disposal plant.

Sewage disposal problem

At El Paso the sewage disposal problem is somewhat unusual since the river flow is controlled, in the interest of irrigation, by the operation of the gates at Elephant Butte dam and since the river bed itself is higher than the ground water table in the surrounding country, thus an unusually large amount of the river flow is lost through seepage in this particular reach of the river. During the irrigating season river flows in excess of 1,000 sec.-ft. may be expected since this amount or more is required to meet the demand of the systems immediately below El Paso. During the non-irrigating season the stream flow is usually about 200 sec.-ft. due to return water from systems above El Paso, but in extreme instances the flow may become nil. The character of the river bed is well illustrated by the fact that in November, 1934, with no flow in the river at El Paso, the sewage, which amounted to 6 m.g.d. disappeared into

the river bed in ten miles of travel. Under these conditions it was decided that the removal of suspended solids is the most important requirement for sewage treatment and that primary treatment with the occasional use of chemicals is sufficient.

The sewage flow averages about 6 m.g.d. with occasional maximum flows of 10 m.g.d. It contains an average of 0.114 lb. of B.O.D. and 0.136 lb. of suspended solids per capita. Due to the relatively high temperatures the sewage is usually stale when it reaches the plant. The design of the plant improvements is based on an average sewage flow of 8 m.g.d. from a population of 120,000.

Disposal plant design data

As constructed, the plant includes the following processes for which design data are also given:

Screening—Duplicate screening units of the comminutor type have $\frac{3}{4}$-in. openings; each will pass 4.5 m.g.d. with a head loss of 3 in.

Grit Removal—Two grit chambers are equipped with cleaning apparatus of the drag type. The grit chambers and screens are combined in one structure and are fitted with gates so that they may be operated singly or in parallel.

Aeration and Mixing—A tank with a detention period of 15 min. is equipped for agitation by compressed air. Air at the rate of 1/25 cu.ft. per gallon of sewage is taken from duplicate blowers located in the machinery building and is applied through porous plates set in the tank bottom. This air agitation serves the dual purpose of partial aeration and mixing since the ferric chloride is added in this tank.

Settling—The aerated and chemically treated sewage is settled for a period of $1\frac{1}{4}$ hr. in a tank fitted with scum-skimming and sludge-collecting equipment of the straight-line type. At normal flow the settling rate is 851 gal. per sq.ft. of tank surface per day and a weir length of 18.5 ft. per m.g.d. has been provided.

The sludge deposited in this tank is forced by the sludge collectors into a hopper at the inlet end from which it is pumped into the digesters by centrifugal pumps of the screw-feed type operated from an automatically timed switch.

The scum is forced by the skimmers to the outlet end of the tank from which point it is raked off by hand into a scum trough and flushed into a separating tank. The grease and floating material is buried and the water is pumped back through the plant.

Sludge Digestion—A total of 2.1 cu.ft. per capita of sludge digestion capacity is provided in nine tanks. Three of these are covered and equipped for heating and for gas collection. The remainder will be left open.

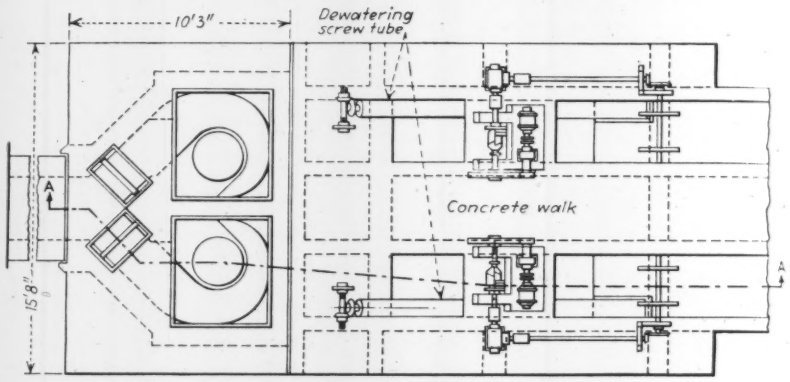
Sludge Disposal—The digested sludge will be air-dried on beds located south of the plant. An allowance of 1 cu.ft. per capita, on beds formed by levelling off the sandy soil, has been made.

Chemical Treatment—Due to high freight rates, none of the commercial forms of ferric coagulants can be used economically at this plant and provision has been made for the manufacture of ferric chloride from chlorine and scrap iron by the Scott-Darcy process. Two chlorinators ,of the solution type, each with a capacity of 300 lb. of chlorine per 24 hr., and three reaction tanks formed of 36-in. vitrified tile have been provided.

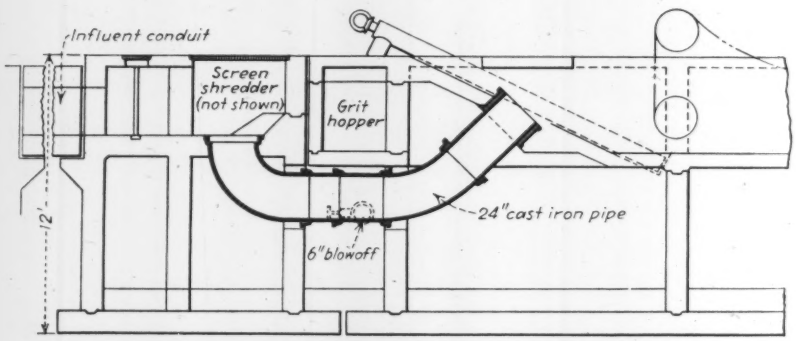
Machinery House—The sludge pumps, air blowers, hot water boiler and chlorinators are located in a two-story building conveniently located with regard to the various operating units. This building also provides space for an office and for laboratory equipment.

Miscellaneous—The project also in-

SIDE OF SHREDDER and grit chamber with racks for chlorine one-ton containers below. The building in the background is the pump and blower house.



Plan of Shredder Screen and Grit Chamber



Section A-A

COMMINUTOR TYPE OF SCREENS and shredders at the entrance to the grit chambers which are equipped with drag-type cleaning equipment.

cluded the construction of a by-pass structure, a 36-in. concrete outfall line and the installation of a venturi meter on the plant outlet.

Construction features

Twelve of the fifteen old septic tanks were used in this project and the remaining three were left for future expansion. These tanks, built in 1922, are in good structural condition and, fortunately, were constructed in units of three tanks, each with outside walls of the cantilever type.

The settling tank was formed by removing the division walls of one of these units, constructing a floor suitable for use with sludge collectors, and installing a steel outlet weir and scum trough.

The digestion tanks are formed of three of the old units or nine tanks and, with the exception of the first unit which is covered, this change involved merely the construction of tank connections, the closing of the old outlet weirs and the installation of suitable drain-off pipes for supernatant liquor.

The first three tanks were covered with a deck of ¾-in. steel plates welded to the bottom of a frame of structural steel which is supported on the tank walls and on concrete columns set in the center of the tanks. The steel members of the framework are incased in concrete poured integrally with a 4-in. slab over the roof deck and so reinforced as to form an independent structure. The lower surface of the roof deck slopes upward toward the gas-collecting domes and presents an unobstructed surface for the passage of gas.

This project, which cost $44,000 was financed by a PWA loan and grant secured by the revenue to be derived from a sewer service charge. It was built by the Drainage Construction Co. of Phoenix, Ariz. Plans and specifications were prepared at El Paso with the assistance of Black & Veatch, consulting engineers, Kansas City, Mo., and the construction work was supervised by the city engineer.

Traffic Regulations Surveyed In Major Cities of Iowa

Despite a multiplicity of conflicting rules disclosed by state planning board study of 13 cities some officials still oppose nation-wide uniformity of traffic control

LACK OF UNIFORMITY in handling traffic in Iowa led the state planning board to investigate in thirteen cities the ordinances, terminal and parking facilities, accident statistics, views on elevated highways and other matters pertaining to traffic regulation. After all the publicity and effort put forth by different agencies at various times to promulgate uniformity the great divergence found is astonishing. In spite of the apparent need for uniformity in methods and systems the representatives of four cities still feel that a uniform nation-wide system of traffic control mechanisms and colors, to indicate definite orders, should not be adopted but left to the discretion of the various local officials. Of these four, two feel that the motor car driver is not thoroughly acquainted with all of the regulations.

The cities included in the study were: Burlington, Cedar Rapids, Clinton, Council Bluffs, Davenport, Des Moines, Dubuque, Fort Dodge, Keokuk, Marshalltown, Muscatine, Ottumwa and Sioux City. Some 117 major questions prepared by the American Road Builders Association were presented by a planning board representative to that official in each town most familiar with local traffic regulations and problems. Those selected included city engineers, traffic or street commissioners, police chiefs or traffic sergeants and a city attorney. The following are some of the results as adduced by the planning board.

Pedestrians are required by law to obey traffic signals and move with the lights in nine cities out of the thirteen, but only one city has made any arrests and laid fines for violations. Twelve cities have limited-time parking; ten of them find this law difficult to enforce. Of these ten, four feel that all efforts to regulate the parking of cars except where they interfere with vision or are adjacent to bus stops, fire hydrants and safety zones, should be abandoned because of the difficulty of enforcement, general lack of respect for regulations and a more or less apathetic attitude toward the situation.

The greatest variation in method and procedure is shown by the returns on the questions relating to traffic control mechanisms, signs and signals. Cities use different colors to indicate identical signals and regulated areas. Only five cities have the progressive-movement type signal systems, and one city has a few vehicle-actuated traffic controllers. One city still permits a right turn on a red light. Two cities maintain their signals in operation 24 hours a day; of the eleven others only three indicate when the signal is off and that a full stop is required.

Safe street design

The answers to questions on design and construction show that much may be done in the matter of safe and economical design. Ten cities feel that smooth street surfaces are contributing to traffic accidents and seven think that it would be good public policy to make an expenditure for a non-skid surface over the existing pavement. Five of the cities are of the opinion that speed is a necessary quality and nine think that cars are being operated at speeds greater than those for which their streets were constructed. At certain times of day in three cities where pedestrians are required to move upon signals, the sidewalks are insufficient to accommodate the accumulation of persons. The design of safety zones in streets presents problems. Seven cities use street car safety zones and of this number five have trouble with drunken, sleeping or inattentive drivers crashing into these obstructions.

Parking and garage facilities complicate problems dealing with construction. Parking in the concentrated commercial sections has its economic aspects, and the regulation in these districts is mainly influenced by the attitude of the merchants. Ten cities state that their commercial institutions feel that the establishment of their own individual parking facilities for customers is a necessity. In the belief that it is more profitable than paying taxes on the original investment, property owners in three cities have wrecked buildings in order to establish parking lots.

Elevated highways considered

The traffic volume has increased to such an extent in four cities that it has become necessary to consider the construction of an elevated highway. It is also felt that a system of public garages in connection with these highways would stabilize property values in the commercial districts. It was indicated that in only two cities would the voters look with favor on such a project, and all of them feel that there would be objections to such a highway over already established streets.

All thirteen municipalities have a system of traffic accident reporting and ten have traffic accident investigation systems. These systems are rather new in some cities and the accident reports are analyzed in only eight of the cities. From these analyses periodic reports are issued in six cities which show the trend of the traffic accident situation. From these reports an accident spot map has already been prepared in eight cities and one has a vehicular traffic flow map made up from intersection counts.

Efficient Refuse Disposal In a Small City

Private and municipal services are utilized in Kingston, N. Y., to remove city wastes at low cost—Design features of a small rubbish incinerator plant constructed with relief labor.

EFFICIENT refuse disposal at low cost is being successfully demonstrated at Kingston, N. Y., where a combined private and municipal system has been adopted to meet the needs of its 28,000 inhabitants. Garbage collection and disposal is handled by private contractors, but ash and rubbish removal, with incineration of the latter, is maintained as a municipal function of the Department of Public Works. The total cost of furnishing this service, including amortization and maintenance charges for new equipment and other facilities, has been under $1.34 per capita during the last year. The rubbish incinerator, completed in August, 1935, was built by the city engineering department with the aid of relief labor and funds. Its construction eliminated three city dumps that were a constant source of civic irritation because of fire and rat nuisances.

Ash and rubbish collection

Kingston is located on the west bank of the Hudson River, about 80 miles north of New York City. The hilly topography, characteristic of the Catskill Mountain region, has an important bearing on the problem of waste disposal so far as economical operation of collection trucks is concerned. All routes have therefore been laid out so that full loads will be brought down hill, and the incinerator has been placed in a low part of the town. Another factor that makes it essential to give careful attention to route layout is the wide distribution of population as indicated by the 85 miles of street within the city limits.

Prior to May, 1934, ash and rubbish collections were made by eight horse-drawn vehicles at an annual cost of from $29,000 to $32,000. These were supplanted by three small 1½-ton motor trucks equipped with 7-cu.yd. dustless type inclosed steel bodies, and enough money was saved in half a year to pay for the new equipment out of the current budget. Another similar unit was added last year to take care of increased haulage to the incinerator. Not only is the new equipment more economical to operate but the covered bodies eliminate the nuisance of dust and ash distribution on the streets.

The city is largely residential, and in addition to the usual ashes and rubbish, large quantities of garden refuse and debris from shade trees must be carted away. Collections are made once weekly, and each truck averages about ten trips (a total of 26 mi.) a day. During the summer months the loads approximate 1,300 lb., but in the winter season this increases to 4,000 lb. because of the ash removal. The trucks are operated with a driver at $4 a day and two helpers at $3.50 per day each. During the four summer months only one helper is used.

THE KINGSTON INCINERATOR is located on the side of a ravine and is so arranged that trucks can dump directly on the charging floor and ashes removed on the lower level for discharge into the ravine.

Garbage collection

Garbage collection and disposal is handled on a contract basis for which bids are taken each year from private operators. The contract specifies curb collections to be made three times each week with ultimate disposal outside the city limits. Close supervision of the work is maintained at all times by the city, and payments are made on a per diem basis. This year the contract called for total payments not to exceed $9,600. The number of taxable properties is about 7,000, which means that the cost of garbage disposal per property averages $1.38, or on a per capita basis, equal to $0.34.

This method of private disposal of garbage has proven highly satisfactory both to the city and the contractor. The latter has taken great pride in the service he is rendering, and recently painted and lettered his trucks to simulate the appearance of regular city equipment.

The distribution of refuse disposal costs during one year of operation has been as follows:

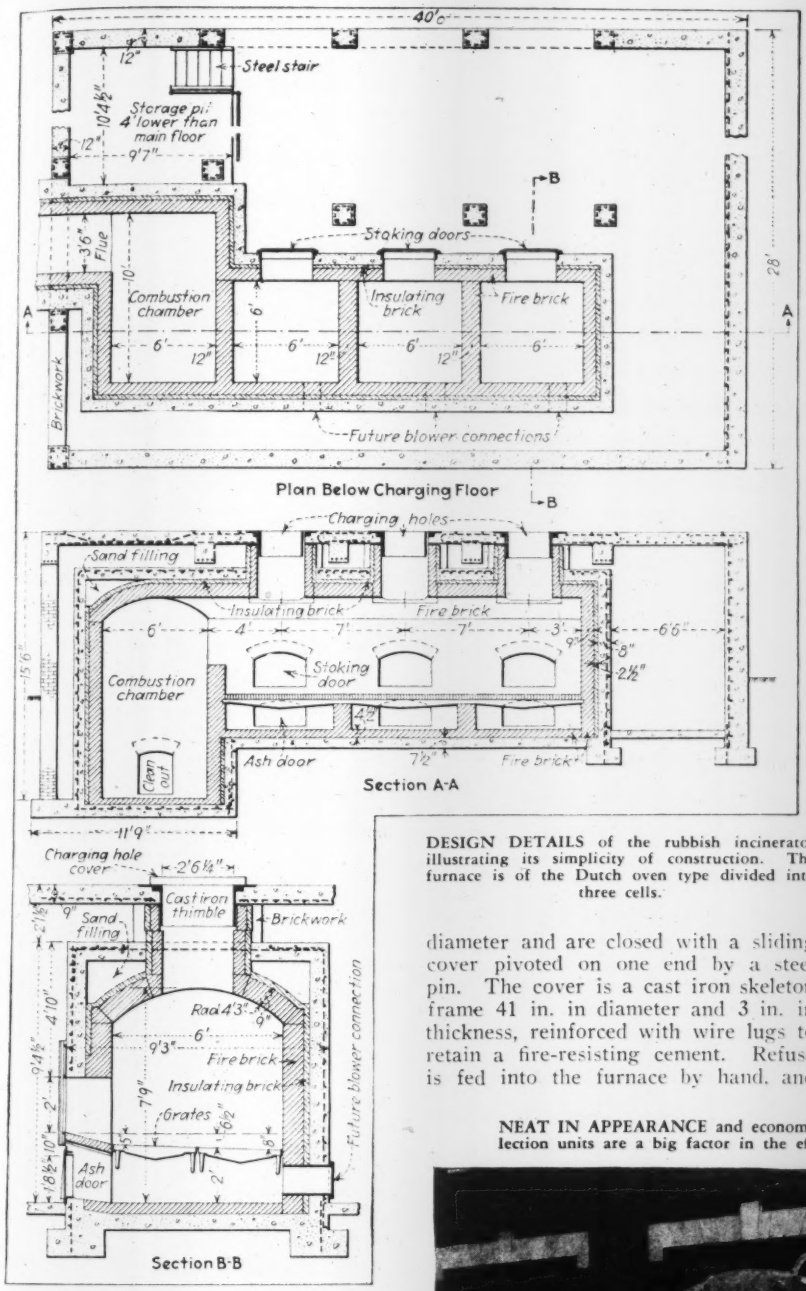
Ash and rubbish removal	
Salaries and wages	$17,500
Purchase of equipment	500
Maintenance of equipment	800
Incidental supplies	1,200
Total	$20,000
Operation cost of incinerator	6,000
Garbage removal	9,600
Total	$36,250
Per capita cost (28,000 population)	$1.333

Incinerator design

The rubbish and trash incinerator, constructed by the city with day labor, is of the "Dutch oven" type, and has a burning capacity of 25 tons in ten hours. The building is a 40 x 28 ft. reinforced concrete structure, with open bays on the ground floor, and 8-in. brick curtain walls above the second floor. Steel roof trusses and purlins support a precast reinforced concrete roof covered with asbestos shingles. The chimney, 100 ft. high, with a 60-in. internal diameter, is constructed of common brick and lined with radial No. 2 firebrick 4½ in. thick. The chimney height is sufficient for future expansion and the burning of garbage if conversion is deemed advisable.

The building is located on the side of a deep ravine which is now being filled with the ashes that emanate from the incinerator. The charging floor is on a level with the roadway, thus giving easy access to trucks. The location of the stoking floor and cleanout pit on an elevation part way down the ravine facilitates ash removal.

The furnace, combustion chamber and flues are inclosed in a shell of reinforced concrete that has been constructed entirely independent of the walls, floors and foundations of the building, in order to give freedom of movement to take care of expansion when the incinerator is operating. The furnace unit consists of three cells, each with a grate area of 36 sq.ft., arranged side by side with no separating walls. The grates are of the stationary bar, cluster type, with a ⅝-in. air space opening. The refractory furnace lining, 9 in. thick at all places except at the floor, where it is 4½ in. thick, is a No. 1 grade firebrick, with a low coefficient of expansion. The brick is closely laid with a calcined fire clay mortar made of the same material of which the bricks are made; mortar paste is composed of 20



DESIGN DETAILS of the rubbish incinerator illustrating its simplicity of construction. The furnace is of the Dutch oven type divided into three cells.

per cent pulverized fire brick and 80 per cent pure clay, with not more than 1¼ per cent hydrated lime. Shortly before the first fire was started the interior of the furnace was coated with high-temperature cement. An insulating material was used between the exterior walls and the fire brick lining of the furnaces.

Charging floor layout

The charging floor of the incinerator is so arranged that trucks can empty their load in close proximity to the three charging holes located directly over the furnace. These holes are 30¼ in. in diameter and are closed with a sliding cover pivoted on one end by a steel pin. The cover is a cast iron skeleton frame 41 in. in diameter and 3 in. in thickness, reinforced with wire lugs to retain a fire-resisting cement. Refuse is fed into the furnace by hand, and in order to protect workmen from accidentally slipping into the charging holes a pipe rail barrier has been erected around each hole.

The combustion chamber, located at the end of the furnace, is 6 x 10 ft. in plan and 11 ft. 9 in. in height. Hot gases traveling from the furnace cells to the chimney first pass over a baffle wall into the top of the combustion chamber and then they are drawn downward and sideward through a 42 x 57-in. flue. This devious routing of the gases promotes thorough intermixing, and thereby insures complete combustion to eliminate the possibility of odor dissemination. The combustion chamber and flue are lined in the same manner as the furnace. The masonry above the flue opening, where it passes through the building wall, is supported by I-beams resting on steel plates. Air spaces on each end of the beam have been provided to take care of expansion.

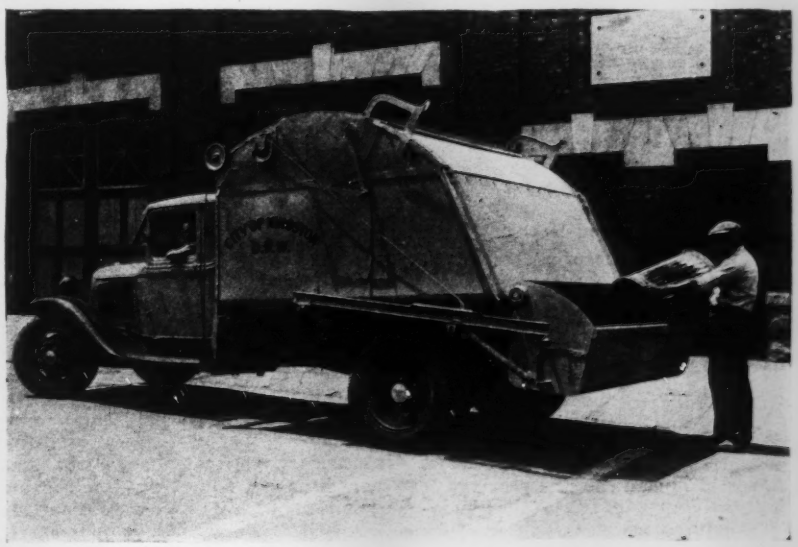
Provision has been made to apply forced draft equipment if future operating conditions require increased air. So far, however, no difficulty has been experienced in obtaining sufficient natural draft.

The total cost of the incinerator, exclusive of the site, was $26,312, of which Kingston's share was $8,453. The sum spent for labor was $12,398, and the materials and equipment cost $13,914.

Direction

Construction of the Kingston incinerator was carried out under the general supervision of James G. Norton, city engineer. Sanborn & Bogert, of New York City, were the designing and consulting engineers, and E. I. McCaffery, of that firm, was resident engineer. Operation of the incinerator and supervision of the refuse collection are under the direction of David P. Conway, superintendent of public works.

NEAT IN APPEARANCE and economical in operation, these modern 7 cu.yd. collection units are a big factor in the efficiency of Kingston's refuse disposal system



Street Lighting and Safety

Night accidents are increasing due to lack of visibility, while daytime accidents are decreasing—Adequate lighting would save 3,500 lives annually

By Paul H. Goodell
Consulting Engineer,
The General Illumination Engineering Co., Cincinnati, O.

DURING 1935 a growing consciousness of the need for accident elimination on our streets and highways has brought about a more thorough analysis of the requirements for improved public safety. Noteworthy in the growing trend toward concerted action has been the recognition of accelerated night accident losses as compared with both the day and overall accident trends.

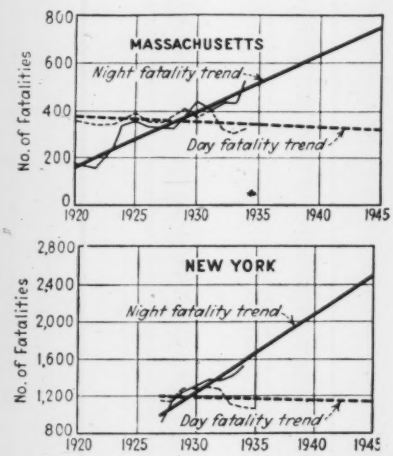
So serious has the night-accident situation become that in many localities statistics reveal that two-thirds of all the fatal and serious accidents are resulting from the small fraction of one-fifth of the total traffic which is making use of our public thoroughfares during the hours of dusk and darkness. An early clew for the remedy to this situation may be found in the Interstate Commerce Commission reports on railroad crossing accidents where it is found that in over one-half of the night-crossing accidents, the automobile is actually driven into the side of the train, rather than the train running into the automobile.

This may sound like "man bites dog" news, but it is nevertheless true that motorists would not deliberately run into trains if existing visibility conditions assured adequate stopping distances with the necessary margin of safety for such unexpected conditions as slippery road surfaces, locked brakes, driving distractions or the many other numerous causes of America's terrific accident toll.

The factor of visibility

Visibility as a factor in traffic safety differs from all others in that it possesses the inevitable and constant element of change. It is not limited to the conditions of a particular corner, to the number of traffic lanes or the many other factors with which traffic engineers are usually concerned. It is in effect an overall factor, the significance of which is indicated in the fact that daytime accidents have in general been on the decline over a period of several years when traffic volumes have actually increased. Contrasted with the rapidly increasing trend of night accidents, however, the need for improved lighting is readily appreciated as a protector of human life and property.

With several years of curtailed budgets for lighting, reflected in the yearly loss of no less than 8,000 lives, city and state officials entrusted with the responsibility for providing sound public works are fast proceeding with the rehabilitation of curtailed and obsolete lighting facilities.



ACCIDENTS INCREASE with night driving as indicated by these graphs which show the auto fatality trend in two states

If public acceptance is given to the expansion of such rehabilitation programs permitting all obsolete lighting to be displaced in conformity with the Illuminating Engineering Society code for adequate street illumination, it is reasonable to expect that 3,500 lives would be saved annually in the cities of the United States. Twice as many more lives would be saved if the major traffic arteries between cities were provided with suitable types of highway lighting as has been shown by accident experience where proper comparisons of adequate illumination have been made with previous existing visibility conditions.

Recognizing the saving not only in large intangible losses from the exacted toll of human life and suffering, but in the costly thousands upon thousands of dollars in hospitalization, property damage, wage losses and excessive insurance costs, many cities have this year installed new types of lighting equipment which provide substantially increased levels of illumination at reduced operating costs. In one county alone in the state of New York, 22 mi. of new highway lighting were dedicated this month and experimental installations are under construction in a dozen more states.

Commendable as the current trend for improved lighting may be, in many cities street lighting is not up to the standard required for modern traffic conditions. In addition, in a great majority of the states expenditures for highway lighting legally cannot be made. Public works officials in these locations are undoubtedly anxious to initiate lighting projects which will return the same favorable results as the newly completed installations which have been reported.

Lack of public interest

The principal deficiency seems to lie in the apparent need of a more concerted public demand for improved lighting. This lack of public interest may to some extent have developed from past impressions that street lighting was only intended to serve an ornamental purpose. Such impressions will be rapidly erased however with the growing knowledge of the crime and accident protection value of adequate illumination. To serve this purpose and thereby help public works officials to emphasize the need for lighting rehabilitation which will lessen night traffic hazards, organizations interested in the promotion of safety are making numerous means available for stimulating the proper public education on safety requirements.

Recommendations and programs are being suggested, numerous forms of publicity are being initiated and means have been provided for demonstrating the hidden element in safe driving which is perhaps better known as "reaction time." Noteworthy among these methods of public education has been the development of the "Accident Meter," a device for demonstrating the rate of accidents and the economic losses which they create. When operated at present accident frequencies which are actually taking a greater toll of American life than did the World War, the demonstration of accident experience is almost unbelievable.

Obviously the three essential requirements for improved safety are careful drivers, safe cars and safe thoroughfares

throughout the full 24 hr. of the day. The "Accident Meter" display contains a complete pictorial demonstration of this approach to safety and has been one of the most successful means of securing concerted action in local safety campaigns.

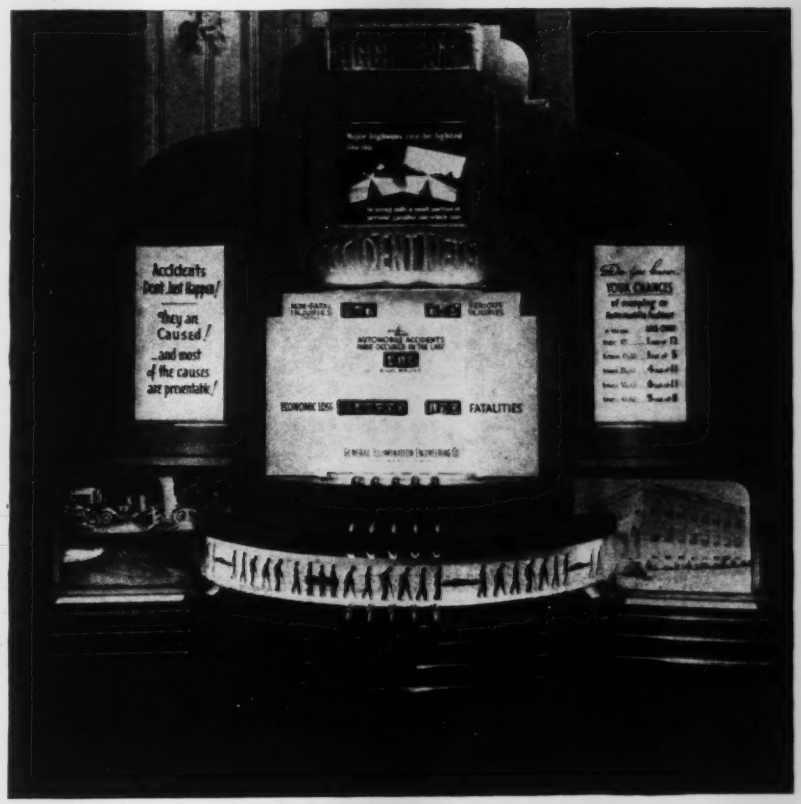
Since the problem of visibility as an adjunct of safety is probably the least understood, because seeing is so often taken for granted, the "Traffic Safety Analyzer" has been developed to supplement the story told by the "Accident Meter" through a practical demonstration of the deficiency in prevailing visibility conditions together with methods for employing illumination more effectively in the elimination of night accident hazards. Demonstrations which thus afford the means for crystallizing public opinion on the importance of progressive works undertakings will not only be helpful to governmental officials, but will bring about improved social standards which cannot fail to reflect commendation on administrative groups large and small.

Recent accomplishments

The past year has seen many other accomplishments, many of them related to the field of illumination and public safety. Such developments which should not be overlooked by public works officials in planning their new projects include improved equipment for utilizing the increasing number of light sources available as tools for accident prevention. Sodium-light sources are increasing in popularity for rural highway illumination and the continued trend of improvements in mercury-vapor lighting has given assurance to its becoming one of the most prominent sources for producing future street illumination.

Of outstanding importance in all the newer types of street and highway lighting equipments has been the improvement in utilization of light more economically to obtain higher levels of illumination. Concurrent with this and of equally great importance is the general trend toward glare reduction by the use of shielding devices, which will permit satisfactory practice without increasing mounting heights even though larger light sources are used.

Shielding in some of the equipments is accomplished entirely by the relation of the light source with the equipment housing, whereas in other types auxiliary means for shielding are provided within the customary enclosing globe which serves the additional purpose of concealing them. Additional light controlling methods of importance are being obtained by incorporating refracting surfaces on the inner wall of the enclosing globe, thus eliminating the necessity for an auxiliary piece of glassware. Lighter weight fixtures of more simple design are increasing in popularity and most of them are made to accommodate all of the principal light sources, excepting sodium which is being confined



THE "ACCIDENT METER" display dramatizes the seriousness of the accident situation.

THE "TRAFFIC SAFETY ANALYSER" permits the operator to test his own "reaction time." Lack of visibility increases this hidden element in safety.

exclusively to highway lighting service.

Progress in public safety is certain to create extensive rehabilitation and expansion in all phases of public lighting during the next few years. Night-traffic hazards will be overcome so that motoring at night will be even more pleasant than in the daytime due to the absence of sunlight glare. Such improved conditions will be brought about by a better understanding and wider public consciousness that lighting is indispensable to safety. Cognizant of these facts, and of their vital relation with the field of traffic safety, the illumination profession is ready to shoulder its responsibility and with the cooperation of public works officials greatly improved standards of illumination are assured.

Air Conditioning Waste-Water Overloads Lincoln Sewers

New municipal problem results in ordinance requiring air conditioning plants to change existing connections from sanitary to storm sewers within period of one year

PROLONGED DROUGHT and high temperatures this summer accentuated the demand for air conditioning in Lincoln, Neb., until that city has as much installed capacity as any city of its size in the United States. Municipal water is used in such large quantities in connection with the air conditioning equipment that the waste-water has overloaded the sanitary sewers of the business district. Results of a recent investigation by D. L. Erickson, city engineer, indicate that additional sanitary sewers must be built or else the users of air conditioners must be compelled to connect with storm sewers. Fortunately the storm sewer system has ample capacity. On Aug. 10 an ordinance was passed requiring all waste-water from air conditioners to be discharged into the storm sewers; existing plants are given a year to comply.

In the downtown business area of 22 blocks all present lateral sanitary sewers are now running either full or nearly full, the 30-in. and 36-in. portions of the intercepter are full, while the 42-in. and 51-in. portions can take an additional load of but 3,000 to 4,000 gal. per minute (g.p.m.). Details of the flow in June as determined by gaging are given in the accompanying table.

Several large buildings and theaters now have air conditioning and indications are that within a short time most of the stores, hotels, restaurants and office buildings in the business district will have some type of cooling system. The 60-deg. temperature of the water supply favors its use in new installations. The amount used depends on the size and construction of the building, degree of cooling desired, temperature of the water and type of installation.

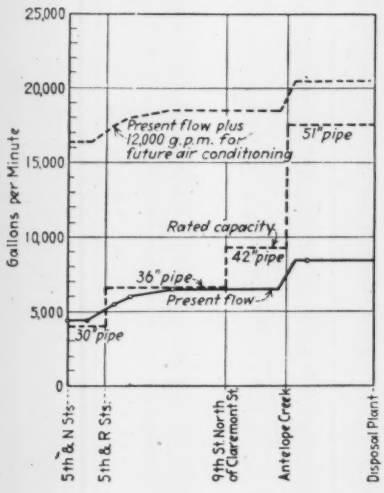


FIG. 1—FUTURE AIR CONDITIONING waste water will badly overload Lincoln intercepters already running full

FLOW OF SEWAGE AT CRITICAL POINTS IN LINCOLN BUSINESS DISTRICT AND IN INTERCEPTER

Location	Depth of Sewage—In.	Diam. of Pipe—In.	Present Flow G.P.M.	Rated Cap G.P.M.
O–P Alley, 13th–14th	8	8	325	325
O–P Alley, 12th–13th	6.5	8	267	270
O–N Alley, 13th–14th	8.5	10	443	430
O–N Alley, 10th–11th	8	12	553	700
N Street at 13th	13	20	2,600	3,400
Intercepter at N St	28	30	4,360	4,000
Intercepter at P St	27	30	4,320	4,000
Intercepter at S St	25	36	5,510	6,560
Intercepter at U St	27	36	5,960	6,560
Intercepter at Y St	29	36	6,480	6,560
Intercepter at cattle barn	25	51	8,450	17,500

In making up an estimate of the ture requirements Mr. Erickson sumed that all buildings in the busi area would eventually come to air ditioning, reducing an outside dry-b temperature of 100 deg. Fahr. to 8 deg. (An all-time record of 115 Fahr. was reached in late July.) inside wet-bulb temperature would 69 deg. and effective inside temperat 76 deg. On this basis the total cool load was estimated at 12,000 tons refrigeration.

Cooling water used will vary from to 8 g.p.m. per daily ton of refrige tion. One large and well designed system with 250-ton refrigeration, carefully engineered, has a maximum water demand of 430 g.p.m. but averages only 200 g.p.m. On the basis of 1 g.p.m. per ton the future load is estimated at 12,000 g.p.m. for the district, or 17.28 m.g.d.

If the present flow, which already largely fills the existing sewers, is increased by 12,000 g.p.m., the overload is much beyond the capacity of the sanitary intercepters as well as the collection system. In order to handle the additional flow in the sanitary system, Mr. Erickson states, it will be necessary to construct additional sewers in each block varying in size from 8 to 21 in. in diameter and an additional 36 and 48 in. intercepter from Ninth and Q sts. to the disposal plant at a cost of $234,000.

By reason of the topography, extra large storm sewers were built, to prevent flooding of basements near the center of the district. The storm sewer capacity here is 449,000 g.p.m., so that the 12,000 g.p.m. additional can easily be handled, since the storm sewer system is practically empty except during a rain.

PWA Employment Passes Its Peak

The highest point, according to a survey prepared by the Bureau of Labor Statistics, in direct employment was reached in June, when 349,572 workers were on PWA payrolls. The highest indirect employment was indicated in July, when orders for materials required in PWA construction reached the year's high of $41,474,532. For the seven months period from January to July, according to the survey, the PWA program provided 178,480,237 man hours of direct employment at construction sites. Payrolls for site workers during the period totalled $133,917,494. Indicative of the amount of indirect work generated in the production, fabrication and transportation of building materials is the figure of $226,841,878—the total value of orders for materials placed during the period.

CURRENT NOTES ON SEWAGE DISPOSAL

An analytical summary of recent developments conducted by

WILLEM RUDOLFS
Chief, N. J. Sewage Experiment Station
New Brunswick, N. J.

ODOR PROBLEMS

The necessity of keeping sewage plants scrupulously clean, so that they are not only pleasing to the eye but also pleasant to the nose, has been frequently stressed. Although most of the odors around sewage plants, especially of the Imhoff-sprinkling filter type, are caused by hydrogen sulfide coming from septic sewage, other odors equally disagreeable may be present. Flower (*Ninth Rept.* Ohio Conference on Sewage Treatment, 12) while emphasizing that volatile sulphur odors may arise from septic sewage, Imhoff tank gas vents and from points where liquids are exposed to the atmosphere, also points out that organic matter undergoing decomposition in screenings, grit, skimmings, sludge and filter stones may produce very offensive odors. The diffusion of the odors, depending not only on the nature of the compounds decomposed but also on atmospheric conditions at the plant, may extend from 1000 to 1400 ft. under favorable conditions. It is quite essential therefore, that operators as well as designers apply their best talents to this problem since not all odors can be eliminated by chemical control alone.

EFFECTIVE AERATION PROCEDURE

The estimation of dissolved oxygen in an aeration tank at any moment presents many difficulties. In the presence of 10 per cent activated sludge, every second of time in active contact results in a loss of oxygen from the liquid, and the sludge therefore cannot be separated from the liquor quickly enough for an accurate result. Watson (*Proc.* Institute of Sewage Purification, 249, 1935) describes a method of arresting biological oxidation by using mercuric chloride which enabled him to obtain accurate results. Similar experiments described by Kessler and Nichols (Sew. Works Jr. 7, 810, 1935) where copper sulfate is used instead of mercuric chloride, are not considered as good.

The real object in making these determinations was to find out in which part of the aeration tanks the oxygen demand was greatest. In the paddle type of aeration, where purification proceeds in a long series of tanks, starting with strong sewage at one end and finishing with a purified effluent at the other, it was demonstrated that with equivalent aeration in every part of the tank there was oxygen enough and to spare at the end of the process, but at the beginning, when the sludge and sewage is greedy for oxygen, there was a big difficiency. The stronger the sewage being treated the greater was this initial demand. The obvious remedy was to reduce the aeration at the end of the process and increase it at the beginning. Accordingly aeration cones in the first tanks were lowered and those towards the end were lifted, and this resulted in marked improvement in the efficiency of the process.

A similar procedure called "tapered aeration" has recently been described in this country by Kessler, Rohlich and Smart (*Mun. Sanitation*, 7, 268, 1936). It has proven to be an effective and economical method of activated sludge plant operation.

SUGAR-BEET WASTE TREATMENT

Plant scale studies on sugar-beet waste, treating from 100,000 to 200,000 gal. per 24 hr. with equipment for coagulation, settling and biological filtration, made by Eldridge (*Michigan Eng. Exp. Sta. Bull.* Mar. 1936) are of general interest. In those cases where a separation of flume and process water is not possible, lime treatment of the combined waste to the amount of 5,000 lb. per m.g., to effectively clarify the mixture, gives only slightly better results than 2 hr. plain settling. The sludge can be ponded or dewatered on vacuum filters. The Steffens sugar-beet process waste has considerable coagulating power and when mixed with combined flume and process water in factory proportions gives an excellent floc and good clarification. As much as 99 per cent removal of suspended solids and 45 per cent B.O.D. reduction is possible. Plain settling of process water produces poor removals but with the addition of 600 p.p.m. calcium oxide more than 90 per cent clarification can be accomplished. The Steffens waste coagulates the process water in the same manner as it does factory waste. Biological filtration of the settling tank effluents showed that about six weeks were required for the development of the filter organisms. The rate of application must be less than 2 m.g.d.; therefore, the results would not warrant the cost, except in extreme cases where the receiving stream is very small.

GREASE DISPOSAL

Grease entering sewage works, especially in large quantities emanating from packinghouses, oil stills and garages, is not only a source of unsightliness and odor but it affects dewatering of digested sludge and has very important bearing on the digestion period of sludge. Greasy scum can be buried for several years without decomposing to any appreciable extent and therefore the problem of disposal is extremely troublesome. Experiences with grease scum at the Cleveland Westerly sewage treatment plant, reported by Wirts (*Ninth Rept.* Ohio Conference on Sewage Treatment, 19) showed that good results were obtained with the incineration of the grease skimmings provided the temperature was kept above 1400 deg. F. The possibility of grease recovery was studied for almost a year but it was concluded that the product obtained had too high a moisture content and was too impure to make the process profitable. Of the various methods employed, controlled digestion was found to be the cheapest and least troublesome process.

SCREENINGS DIGESTION

Attention was called to the use of leafmold as an economical method of starting alkaline digestion in poorly operating tanks (*ENR*, Dec. 26, 889, 1935). Experiments have now been reported by Lesenyei (*Gesundheits Ingenieur* 59, 454, 1936) on the digestion of coarse and fine screenings with the aid of different types of rotted leaves. The sources of the leaves were acacia, acorn, linden, elm and mulberry trees. Gas production with mixtures of 1.5 parts leaves to one part of screenings on a dry solids basis were substantially the same as those produced by sewage sludge, although the carbon dioxide content was slightly higher. Reduction of organic matter amounted to about 47 5 per cent; the organic material of the leaves was somewhat more resistant than that of the screenings. The experiments show that rotted leaves can be used with good results.

Results on the digestion of screenings under thermophilic conditions were similar to those reported previously in this country, namely, rapid destruction with somewhat more gas produced than under low temperature conditions.

Book Reviews and Notes

A Monthly Commentary on Current Additions to the Civil Engineer's Library

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Steel Structure Design

ANALYSIS AND DESIGN OF STEEL STRUCTURES—By Almon H. Fuller and Frank Kerekes. Cloth; 6x9 in.; pp. 627; photographs, linecuts, tables. Published by D. Van Nostrand Co., Inc., New York. Price $5.00.

TWO WELL-KNOWN TEACHERS have collaborated in the preparation of this new text whose outstanding characteristic is its unusually wide scope. The 600 pages contain information planned for use in an elementary design course, in an advanced undergraduate course in bridges, and in an advanced undergraduate course in buildings. The chapter on industrial buildings is labelled "Industrial Buildings" and not "Mill Buildings," which in itself is an innovation; tier-framed structures as well as mill type are covered. In the chapter on moving loads on trusses influence diagrams are discussed and locomotive wheel load tables and diagrams presented. The economics governing the proportions of simple span bridges is the title of another useful chapter. Statistically indeterminate structures, continuous frames and secondary stresses and wind bracing analysis in multistory buildings are among the other subjects treated in some detail. Considerable data are included pertinent to timber design with respect to the use of timber for falsework, for scaffolding and for industrial building framing and trusses. The appendix includes the A.R.E.A. specifications for steel railway bridges and the A.A.S.H.O. specifications for highway bridges.

Up-to-Date Concrete Design

REINFORCED CONCRETE—By Robert A. Caughey. Cloth; 6x9 in.; pp. 292; linecuts and tables. Published by D. Van Nostrand Co., Inc., New York. Price $3.75.

THOROUGH CORRELATION with the most up-to-date theory and practice gives this book major importance among contemporary texts on reinforced concrete. Born by way of mimeographed class notes, later developed in a lithoprinted edition and thoroughly revised before this present printing, the subject matter is well geared to student as well as practicing engineer requirements. As an example of its up-to-date character may be mentioned the use of the 1936 A.C.I. specifications in the problem and design work. For columns, the new as well as the old formulas are used. An innovation is the inclusion of a chapter on composite beams of concrete and structural steel, recognized for the first time in the 1936 A.I.S.C. specifications for steel for buildings. The subject of beams is also covered by presenting the five important methods of obtaining moments: (1) elastic curved beam theory; (2) moment areas; (3) moment distribution; (4) conjugate points, and (5) slope deflection. The method of moment distribution is also applied to multistory building frames. Wheel load distribution theories for concrete slabs are fully covered and a chapter is devoted to arches and rigid frames. The book plan is based on the solution of many problems. The 1936 A.C.I. specifications are published as an appendix.

Earthquakes

EARTHQUAKE INVESTIGATION IN CALIFORNIA 1934-1935—Serial Publication No. 201, Coast and Geodetic Survey, U. S. Department of Commerce, 1936. Paper 6x9; pp. 231; illus. 124; tabl. 53. For sale by the Superintendent of Documents, Washington, D. C. Price 35c.

THE PROGRAM of investigations covered in this publication was initiated after the Long Beach earthquake of March 10, 1933. Made possible by a PWA grant, the work was carried out under the supervision of the Coast and Geodetic Survey with N. H. Heck in charge. The program was rendered more effective by the cooperation of a number of specialists who acted in advisory capacity without recompense, and by the public spirited attitude of Californians who permitted the accumulation and publication of vibration data relating to their buildings. Among the collaborators mentioned are: Allen, Benioff, Blume, Byerly, Creskoff, Cortlett, Day, Gutenberg, Jacobsen, Maher, Martel, McLean, McComb, Merritt, Millikan, Neumann, Richter, Robison, Ruge, Ulrich, Weed, Wenner and Wood.

The first two chapters outline the organization of the field parties and the scope of their work, delve into the various types of instruments used in the investigations, and give instrumental test and field records.

Chapter 3 discusses theory used in the analysis of accelograms and seismograms. The strong motion instruments which are so useful in recording the action of major earthquakes are accelographs; their records, accelograms, yield data concerning the amplitudes and periods of accelerations only. Engineers, however, are particularly interested in the interpretation of acceleration amplitudes and periods in terms of displacement amplitudes and periods. The method of double integration as developed by A. Blake of the Coast and Geodetic Survey accomplished this purpose at a considerable saving of paper work over the conventional routine. To F. Neumann of the Coast and Geodetic Survey, however, must go the credit of devising recently a mechanical method of double integration, based on the principle of the torsion pendulum, which reduces analytical work to a minimum.

Chapter 4 deals with the questionnaire method of collecting seismic data in order to determine earthquake intensity as a function of structural damage inflicted.

Chapter 5 contains a vibration theory by L. S. Jacobsen, and furnishes observations and test results concerning the vibrations of sites, buildings, bridges, dams, elevated tanks, etc. Data on the vibration of 212 important buildings of various types, dimensions, cross-sections, and end conditions are given in Table III. Among these are observations on buildings when partially and then when fully constructed; also data on buildings both before and after major alterations were completed. This chapter contains experimental data of fundamental value to engineers.

Chapters 6 and 7 deal with the interpretation of structural vibrations, with the computation of elevated tank periods, and with the site and building vibrator by which sites and structures are forced into vibration. Forced vibration experiments and records are given, showing the importance of synchronism.

A report of the earthquake damage to type 3 buildings during the Long Beach earthquake is given in Chapter 8. The data show that buildings were less damaged on soft than on consolidated ground; that row buildings fared better than detached ones; and that the percentage of damage decreased with the number of stories.

Ground periods during Southern California earthquakes; the development of a 4-unit portable seismograph by H. Benioff by means of which observations can be made on the simultaneous movements of the various floors of buildings during aftershocks; and the testing by triangulation of earth movements in California which may occur prior to destructive earthquakes are covered in Chapters 9, 10 and 11. The book is an outstanding contribution to seismological engineering.

EARTHQUAKES—By Nicholas Hunter Heck. Cloth; 6x9 in.; pp. 222; photographs, linecuts. Published by Princeton University Press, Princeton, N. J. Price $3.50.

BY COINCIDENCE, the above review of a publication containing the most up-to-date engineering data on earthquakes can be accompanied by the review of a book which sets forth the fundamentals

of earthquake study and the state of present knowledge. The author of this latter book also was in charge of the studies reported in Special Publication No. 201, noted above. In his book on earthquakes Mr. Heck writes for the beginner in the earthquake field, be he engineer or layman. Theories of earthquake causes and actions are discussed followed by explanations of studies with and without instruments and of interpretation of records obtained with modern strong motion instruments. Descriptions of the great earthquakes of the past and the damage that they caused are presented. The methods of regional study that produced Special Publication 201 are set forth. The book is an earthquake primer, the first to be written from the engineering as contrasted with the scientific viewpoint.

Steel Structures

Reviewed by Robins Fleming
American Bridge Co., New York

FINAL REPORT OF THE STEEL STRUCTURES RESEARCH COMMITTEE—Department of Scientific and Industrial Research (British) Paper, 6x10 in.; pp. 599, numerous diagrams, halftone illustrations and tables. Published by H. M. Stationery Office, London. 12s. 6d. British Library of Information, 270 Madison Ave., New York, N. Y. $3.40 including postage.

THE first and second reports of the British Steel Structures Research Committee were reviewed in *ENR*, Feb. 18, 1932, p. 259 and July 26, 1934, p. 118. The report now under review, the third and final report, is more voluminous and is more detailed in recommendations for design than the two previous reports. The committee emphasizes that the objections to existing design methods are inherent in the assumption that the horizontal steel beams in a steel frame building are freely hinged or pin-jointed to the vertical columns or stanchions. (Throughout the report columns are called, after the British fashion, "stanchions"). "The difficulty before us has been to take into proper account the rigidity of the connections and the continuity they impose on the structures, having regard to the various types of connections in use and their different degrees of rigidity."

The entire volume with the exception of the committee report is given to investigations into the design of building frames and to recommendations for design. Professors J. F. Baker and C. Batho are authors of the different sections. Associated with them are P. D. Holder, S. D. Lash, E. H. Bateman and E. Leander Williams.

The first three sections are given to an investigation of the shear distribution in the framework of a hotel building, an office building and a residential flats building. The seven-story hotel tests were made on the bare steel frame; on the frame with floors laid; on the frame with floors laid and columns cased. The tests on the three buildings are studied in the section following. "It is, however, a far cry from the details in the laboratory and the experimental type of frame to the complicated structure, fabricated and erected under normal commercial conditions." It is hard to imagine such tests being made in America.

Important sections are those given to beam-and-column connections, the design of beams and the design of columns. A section is given to the effect of wind loads on frames with semi-rigid attachments. The committee did not have very high buildings in mind.

"Recommendations for design" provides for the stresses caused by vertical forces. Part 1 relates to the design of beams. A striking innovation is the classification of connections of beams to columns as one of the factors of strength. The classification shown is for the cleats at the top of the beam but the bottom cleat must be at least as srong and as strongly connected as the top cleat. Tables are given for use in the design of beams with "Class A," "Class B," "Class C" and "Class D" connections. A method is given for the determination of the end restraining moments in beams.

Part 2 is entitled "Design of Stanchions." "The stanchion lengths in a multistory building are almost without exception subjected to appreciable end moments by the beams framing into them." Tables are given for determining the total bending moment due to live load and to dead load in the bottom, intermediate and topmost lengths.

From this review it is obvious that the proposed method of design is radically different from those now commonly used. It can only be followed by giving to it considerable study and time. The method requires lighter beam sections and heavier column sections than by present methods although it is stated that if the rules are used intelligently it is unlikely that the total weight of columns will be seriously increased.

Miscellaneous Notes on Booklets and Reprints

NEW SPECIFICATIONS for steel for buildings utilizing a 20,000-lb. per sq.in. basic unit stress and incorporating other changes (*ENR*, Sept. 10, 1936, p. 385), are available from the American Institute of Steel Construction, 200 Madison Ave., New York City.

SPECIAL CEMENT DATA are available in two booklets, the first, an interim report to the Second Congress on Large Dams held in Washington, D. C., during the week of Sept. 7, and the second a 230-page booklet entitled "Special Cements for Mass Concrete," prepared by J. L. Savage, chief designing engineer of the U. S. Bureau of Reclamation as a summary of all available information in this country, including that which resulted from both the Boulder Dam and the Grand Coulee Dam studies. (Obtainable from the Bureau of Reclamation, Washington, 75c.) The first booklet contains the 100-page report of the international subcommittee on special cements covering methods of testing relative to heat of hydration, corrosion, shrinkage, permeability and workability. It may be obtained from International Commission on Large Dams, 5, Avenue Friedland, Paris 8.

THE STEEL RIGID FRAME TESTS at the Bureau of Standards have progressed to the point where a second report is available, covering tensile tests of coupons cut from the first frame tested and also results of load tests on this frame with the outer corner reinforcing plates removed. These latter results indicate a stress distribution not greatly different from that reported (*ENR*, Feb. 27, 1936, p. 313) for the frame with the reinforcing plates, namely, 12,000 lb. per sq.in. maximum tension located well inward from the outer knee, and maximum compression of about 18,000 lb. per sq.in. at the inner corner. The coupon tests reveal a Young's modulus of elasticity of 28,600,000 lb. per sq.in. The report is available from the American Institute of Steel Construction, 200 Madison Ave., New York City.

New Books and Revised Editions

[Those desiring copies of the books listed below or mentioned elsewhere in this section should order them from the publishers or from their local booksellers.]

A CLASS BOOK OF MAGNETISM AND ELECTRICITY—By H. E. Hadley. Cloth; 5x7½ in.; pp. 512; photographs, diagrams, tables. Published by Macmillan & Co., Ltd., London, and the Macmillan Co., New York. Price $2.50.

DESCRIPTIVE GEOMETRY PROBLEM BOOK—By Frank W. Budd. Paper; 11½x8 in.; pp. 12 and 300 problems; linecuts. Published by The Macmillan Co., New York. Price $1.75.

FIELD ENGINEERING TEXT TABLES—By William H. Searles. 21st edition. Fabricoid; pp. 403; 4x7 in.; linecuts and tables. Published by John Wiley & Sons, Inc., New York. Price $4.50.

GENERAL CHEMISTRY—By Harry N. Holmes. Cloth; 6x9 in.; pp. 700; halftones, linecuts, tables. Published by The Macmillan Co., New York. Price $3.50.

MARINE PILING INVESTIGATION—Second progress report of the New England Committee. Paper; 8½x11 in.; pp. 249; maps, charts, test board results. Published by the New England Committee on Marine Piling Investigation, 150 Causeway St., Boston, Mass. Price $2.00.

STATICALLY INDETERMINATE STRESSES: AN ELEMENTARY TREATISE—By John Ira Parcel and George Alfred Maney. Second edition. Cloth; 6x9 in.; pp. 432; linecuts and tables. Published by John Wiley & Sons, Inc., New York. Price $5.00.

THE FIFTIETH ANNIVERSARY OF THE SOCIETA EDISON 1884-1934. Four volumes. By various authors. Each volume cloth; 9x13 in.; total pages 1,947; halftones and linecuts. Published by the Societa Edison, Milan, Italy.

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Local Pride vs. Safety

MUCH WORK REMAINS for the various agencies working for uniform traffic regulations. A recent study of conditions in thirteen principal cities in Iowa shows a woeful lack of uniformity, and what is more discouraging, is a feeling that rules, regulations, markings and signals should be left to the local officials. Thus a motorist, even without leaving his own state, encounters conditions in which he must have an encyclopedic mind if he is to keep from violating traffic rules, some of which are in conflict. Iowa is not peculiar in this respect; similar irrational and unnecessary traffic rules are found in every state; in some the rules change at county lines within a single community. This situation calls for burying much local pride in the interests of the maximum amount of uniformity throughout the nation, not simply to obtain uniformity but because greater uniformity means greater safety.

A New Burden

THE ENORMOUS DRAFT on waterworks systems that can be occasioned by air conditioning plants is well illustrated at Lincoln, Neb., a hot town in summer. The progressive merchants of that city have proceeded to do something about the weather and have put air-conditioning science to work; as a result, all the downtown sanitary sewers now are running full of cooling water. This would be serious were it not for the fact that the city has a separate system with a storm sewer of ample capacity to which the air conditioners can be connected. An ordinance requiring such connection recently was passed by the city. But what of the water supply? Four years ago Lincoln laid down one of the longest 36-in. cast-iron pipes in the country to bring in water 25 miles from wells sunk in the gravel bed of the Platte River near Ashland, and the new facilities were supposed to be adequate many years. When all the business houses in Lincoln are air conditioned the extra demand for water, based on present consumption data, will be more than 7 m.g.d. This is a sizeable burden particularly as it comes at the time of existing peak consumption. Thus waterworks officials are brought face to face with the practical side of a new and unexpected load that few dreamed of a decade ago.

Wider British Roads

AGAIN the British Ministry of Transport has hit the tradition of winding English roads and draping hedgerows. In a report recently issued it asks a 60-ft. right of way for single roadway and increased width of 80, 100, 120 and 140 ft. as the traffic carried calls for two, three and four lanes and as cycle and foot paths are needed. A 10-ft. traffic lane is the minimum width considered and this should be increased to 11 ft. where "a large proportion of industrial vehicles is likely." But the notable demand is that "where a road is to carry 400 vehicles at the peak hour or in any case where more than two traffic lanes are necessary, the roadway should be divided to separate opposing traffic." These standards while not notable for the dimensions required are the indication of a rapidly growing consciousness that the modern highway is to serve transport and not to dictate to it. Today all but a minor mileage of highways have inadequate roadway and poor alignment. Like Great Britain, all the world has the task of fitting its roads to new demands of transport.

Parks Get in the Money

STREETS, water supply and sewers have been the big items on all city budgets for many years. Far down on the list, parks have been a perennial item perfunctorily inserted by the budget makers and practically painless as far as the taxpayers are concerned. A change in this situation is imminent. Thanks to the federal Santa Claus of work-relief nearly every city has received vastly improved park facilities. Moreover, these facilities have been such as to invite usage by the people, and parks have suddenly risen to a position of high esteem. They have become an indispensable part of the lives of the people, as streets, water supply and sewers have been before them. And as with streets, water supply and sewers, they require large sums of money for their upkeep and necessary expansion. Parks are, in short, in the money. So far, it has been federal money. But next year parks revert to municipal control, and budget makers are presented with a new problem. In New York City, Park Commissioner Robert Moses posed the problem by asking an increase of nearly 100 per cent for 1937, the total being about $10,000,000. "We have brought the city recreation program up to date," said Mr. Moses, "and now we have to decide if we want to keep it there." Other cities face the same decision, which resolves itself into meeting the wishes of the people. Consequently large park budgets seem destined to become a permanent fixture in city finances. And when the money is appropriated, it is the public-works departments and the city engineer's offices, in many instances, that must spend it wisely and efficiently. It is a new and added responsibility, but it should be welcomed. Park upkeep, operation and expansion afford a bright new field for impressing the public with the services of the engineer. By embracing their new opportunity, city engineers will serve their profession as well as their city.

Across All Boundaries

THE QUESTION most frequently asked of those who attended the World Power Conference and the Congress on Large Dams is: Was it worth while? The answer is: Yes, very much so. The value, however, was not so much in what went on in the formal meetings as it was in the contacts made and in the knowledge gained of wherein our problems are the same as those of other countries and wherein they differ. It is interesting to note further that in the power conference most of what was said indicated that each nation has its peculiar problems and meets them in a way that would not be satisfactory in other countries because of legal or physical differences, whereas in the dam congress the problems discussed were similar and the manner in which they were met would have been widely applicable. Engineering problems, unlike many social and economic problems, know no national boundaries.

Mosquito Control in Public Service

SINCE ITS ORIGIN four decades ago that little known type of engineering work known as mosquito control has developed to a point where its intimate relation to the public welfare is no longer in question. Today engineers of many different kinds must concern themselves with it—every city and county engineer as well as many of the men engaged in hydraulic and even general construction operations. Unfortunately the subject has remained a closed book to most of them, and only a limited number of specialists can be said to possess more than superficial knowledge of its principles and practices.

To make the essentials of the subject readily available, *Engineering News-Record* recently requested the cooperation of a group of recognized authorities in preparing a concise, practical presentation that would cover all phases of effective mosquito fighting. The series of articles written by these authorities came to a close in last week's issue. It provides the engineer with a useful compendium of working information on a subject of rapidly growing public importance.

Surviving from the early days of the art, there still is a tendency to think of mosquito eradication or control as primarily a medical matter, or at best one of health inspection. The actual fact is that it is in every sense an engineering problem—a point well brought out in our series of articles. Its engineering character is defined by the very nature of the operations which it involves. In addition, however, the planning and execution of most works for water storage and drainage involve mosquito hazards. Often such undertakings include no provision for minimizing the risk of mosquito propagation, and as a result hydraulic engineers frequently do much unwitting harm by aiding and abetting the development of a pest that not only is a mass carrier of disease but also occasions large economic loss to mankind.

To realize the importance of the matter one need not go back to the classic example of the Panama Canal, where Col. Gorgas with the solid backing of John F. Stevens wiped out the deadly yellow-fever mosquito and made mosquito control the indispensable first step in canal-building. Recent examples are no less convincing. Among them is the studied attention given to mosquito problems in connection with some of the large storage and impounding reservoirs of the South, especially those in the Tennessee Valley.

A different but no less notable demonstration of anti-mosquito work is the long-time campaign in New Jersey to control pest mosquitos, a campaign which, it is estimated, has added a half billion dollars of taxables to the state's wealth. And it should be noted that, while this campaign was motivated wholly by the desire to end an intolerable annoyance rather than by the purpose of preventing disease, the malaria hazard is no less real in New Jersey than in the South, as is proved by a recent epidemic that followed a let-up in one county's mosquito work.

Responsibility for combating the mosquito menace is shared by all engineers engaged in construction, for even a simple grading job through neglectful creation of mosquito breeding places may neutralize the protective efforts of an entire community. Yet the main responsibility rests on the public-service engineer, and in view of the increasing economic significance of mosquito control it must be ranked among his most important obligations. In the future no community that neglects adequate attention to mosquito hazards can claim to be serving properly either its own interests or those of its neighbor communities, and no municipal engineer who fails to provide for control work in his program can claim to be discharging his full duty.

Control work requires as careful a program and budget as does pavement maintenance or sewage-plant operation. All planning of improvement works demands full consideration of existing mosquito hazards and potential new ones. To make local efforts effective it may be necessary to negotiate regional cooperation or to assure it through legislative measures. Public support will be essential, and to obtain it the officials and engineers may have to carry on public education in the subject. At all points a thorough understanding of the fundamentals of the problem and a knowledge of practical procedure is vital. By providing this knowledge and understanding the series of articles just concluded will, we hope, prepare engineers to render better public service.

Brightening Horizons

IN SEVERAL QUARTERS a feeling of concern has been expressed regarding municipal works activity when PWA and WPA funds are no longer available. Only a meagre amount of normal municipal enterprise has been possible during the past few years, due to conditions fostered by the depression, and had it not been for federal funds the situation would have been far worse.

Turning back to the period prior to 1930 it will be recalled that at that time our communities were actively engaged in developing facilities to meet the needs of growth and the demand for increased services created by scientific progress. But even with the exercise of extraordinary efforts it was not possible to maintain a pace of accomplishment that adequately satisfied immediate needs, let alone those for the future. Then came the depression period and with it the drastic curtailment of expenditures that caused practically a nation-wide cessation of municipal maintenance and improvements. This interruption did not lessen needs but, on the other hand, it accentuated them. Very little was or could be done to provide for current or coming requirements, and meantime obsolesence and deterioration of existing facilities continued unabated. As a result there now exists a huge back-log of urgently required work to make up for the shortcomings of the last half-dozen years.

What then are the prospects for financing and getting started on this work? To this question a heartening reply can be made. Tax receipts, many of them long delinquent, are increasing daily; municipal credit has been rehabilitated and there is now an excellent market for the sale of municipal bonds; and, finally, private capital is willing and eager to advance money at unbelievably low rates of interest. Couple all this to the insistent and growing public agitation for better community facilities and the combination is one that cannot fail to provide impetus for action.

In resuming activity, municipal authorities are faced with obligations whose proper discharge calls for the most skillful kind of planning in both financing and construction operations. Engineers and public works administrators should be prepared to take full advantage of these rich opportunities for service in their chosen field.

CURRENT NEWS

Large PWA Grant For Skagit River Power

Further allotments for the new PWA construction program, announced September 21, include grants of $9,531,459 and loans of $264,500 for 103 projects estimated to cost a total of $21,733,568. This brings the total of September allotments to 494 projects with a total estimated cost of $65,670,561.

The largest single grant in the latest list is $3,000,000 to the city of Seattle, Washington, for extensions to its Skagit River water and power development, including a new dam and 125,000-acre-ft. reservoir and a 240,000-volt double-circuit transmission line from the Diablo Plant to the city. Total cost of the present program is set at $7,185,000, but the federal grant will be used only for that portion of the work which can be done by unemployed labor now available, including such items as preliminary clearing, foundation work, and the erection of incidental structures.

The dam will be constructed, for the time being, to a height of 290 ft., but will ultimately be extended to 625 ft., second only to Boulder Dam. The enlarged reservoir will give an additional storage of 3,800,000 acre-ft. and will, it is believed, give complete river regulation, eliminate the flood problem, and supply the city's electrical needs for many years.

Of the remaining approved projects, none involves a grant of more than $1,000,000, and most are for less than $100,000. They include hospitals, asylums, schools, waterworks, sewer systems, municipal buildings, bridges, highways, and other public improvements. Only eight municipalities requested loans.

All grants are made on a basis of 45% of the total cost of labor and materials, subject to acceptance by the applicants of conditions to be extended by PWA.

Maine Forbids Gas Tax Diversion

A constitutional amendment forbidding the diversion of highway funds to other purposes was passed by a large majority in a referendum held in Maine at the time of last week's election.

No permanent diversion of gasoline tax funds has taken place in Maine, but it has been the practice to borrow from the highway fund, and there were rumors that it was planned to attempt a permanent diversion of the funds in the next session of the legislature.

Passage of this bill makes Maine the fourth state to take legal measures to protect highway funds; Missouri, Minnesota, and Colorado have already prohibited diversion of highway funds through constitutional amendments. A petition is now being circulated in Massachusetts for a referendum on a similar amendment.

Concho and Colorado Rivers in Flood

Several lives lost and damage estimated at $3,000,000—Bridges out—San Angelo temporarily isolated

RECORD floods on the North Concho, Concho, and Colorado Rivers in Texas have caused damage estimated at more than $3,000,000 and the loss of a small but undetermined number of lives. Damage was concentrated at the city of San Angelo, located at the confluence of the North Concho and Concho Rivers, where property damage was estimated at $1,500,000 to $2,000,000. Two lives were lost in San Angelo.

The flood was caused by a cloudburst in the Concho watershed. On the night of Sept. 16, 20.38 in. of precipitation was recorded at Water Valley, 25 miles south of San Angelo. At other points, 10 to 15 in. fell in 48 hours, and the total for the week in some localities was as high as 35 in.

The flood waters of the Concho entered the Colorado River when that stream was just beginning to recede from a flood stage of 20 to 50 ft. caused by heavy rains, from 16 to 20 in. during the week, throughout the Colorado watershed. At Rockwood, on the Colorado River, a short distance below the entrance of the Concho River, the flood stage on Sept. 19 rose to 70 ft., a new high mark. At the same date the San Saba River, 50 miles below Rockwood, was turning a flood of its own into the Colorado. On Sept. 21 the lower Colorado was still rising.

Among the larger bridges which were wholly or partly destroyed were a bridge across the Concho River at Christoval, steel highway bridges across the Colorado River at Stacy and Rockwood, Concho River bridges at Miles and Paint-Rock, a bridge across the Colorado at Garwood, and a railroad bridge of the St. Louis and San Francisco line at Winchell.

Except in San Angelo, no report has been received of damage to or interference with the operation of public utilities. The waterworks and electric plants in that city were out of commission for a short time, but no serious damage was done to them.

International News Photo

THE FLOODED NORTH CONCHO River piled this mass of debris under the Chadbourne street bridge in San Angelo, Texas.

LOCATION of the Concho and Colorado Rivers in Texas.

Engineering Supervision of Construction Sought in N. Y. C.

Mayor LaGuardia of New York City has announced his intention to support a municipal ordinance requiring that all construction work in the city be under the supervision of a registered architect or a licensed professional engineer.

The mayor made his statement after he received the report of a committee which he had appointed to investigate building conditions in the borough of Queens. The committee was made up of representatives of various technical societies.

The committee found that construction methods and results were very inferior. Concrete used in foundations was below standard in every case where the committee made an inspection, the report said. Important structural members in houses were cut to permit passage of pipes; header beams were cut in such a manner that their strength was seriously impaired; wood sills were found not bearing on the foundation walls for a considerable distance; joints in cast iron pipes were not properly calked; and various other infractions of the building laws were discovered.

The committee recommended in its report that the building laws be amended

to provide that all building plans filed should bear the seal of a registered architect or a licensed professional engineer, who should be required to supervise the construction of the building.

New TVA Policy Will Be Discussed

President hopes to negotiate agreements for joint operation of public and private utilities to form grid

Washington Correspondence

PRESIDENT ROOSEVELT has called, for September 30, a meeting of private utility and financial leaders with representatives of government departments interested in power, which may end the present active hostility between the advocates of public and of private ownership of utility facilities.

The immediate reason for the conference is the need for negotiating a new contract to replace that expiring November 1 providing for the interchange of power between TVA and the near-by operating companies of the Commonwealth and Southern system —the Alabama, Georgia and Mississippi Power Companies and the Tennessee Electric Power Company. But this will be only the starting point, for the President, in his announcement, indicates that if a satisfactory agreement can be reached in the Tennessee Valley, a basis will perhaps be laid for similar arrangements in other regions affected by federal power projects.

In explanation of the scope and purposes of the conference, the President said:

"The public interest demands that the power that is being or soon will be generated by the Tennessee Valley Authority and at the Bonneville Dam and other public works projects should be made to serve the greatest number of our people at the lowest cost and, as far as possible, without injury to existing actual investment. . . . This objective can best be obtained by cooperative pooling of power facilities within each region, including those of the federal projects, the privately owned utilities, and the municipal plants, through the joint use of the existing transmission line networks under the control of the members of the pool. Such a pool, it appears, will smooth out the peaks and valleys of separate system operations, reduce the amount of necessary reserve capacity, and postpone the need for investment in new generating facilities. . . . These great savings, based on fair contractual relations between the public and private agencies participating, should make it possible to bring cheap and abundant power to the gates of every community in the region at uniformly low rates."

The expiring contract was signed in January, 1934, between TVA and the four Commonwealth and Southern Companies, as well as the parent company. At that time the newly-organized TVA had ample generating capacity, at Muscle Shoals, but no distribution facilities. In return for the right to buy surplus TVA power at low rates, the companies sold to the Authority certain distribution facilities in the valley and agreed to a division of territory. A clause of this contract was the basis of the **first TVA suit**, decided in the government's favor last spring.

Since that time intensive sales promotion in the region has brought about a great increase in power consumption. The availability of cheap TVA power together with the difficulty of adding to capital expenditures during the depression have prevented the companies from adding to their generating facilities. The result is that the impending end of the interchange contract leaves the companies the choice of either immediately entering upon an intensive construction program or of negotiating a new agreement with TVA.

The tenor of the President's announcement indicates that the Administration hopes to utilize this situation to bring about a general pooling agreement involving all regions in which federal power projects are located. What the government has to offer is large blocks of cheap power located, for the most part, at considerable distances from large consuming centers. What it hopes to obtain, as the President's words indicate, is a general integration of privae and public power systems, including municipal plants, and low rates which shall be uniform over an entire region. Who shall manage this integrated system is left unspecified.

The position of the southeastern companies has already been outlined; the other utilities can offer their extensive distribution facilities and an end to interminable and expensive legal warfare. They stand to gain relief from the constant threat of competition from public power-plants.

GETTING THE TRAINS OFF SYRACUSE STREETS

Six miles of track were elevated, 29 new bridges were built, and $17,000,000 was spent to take the New York Central and West Shore trains off the streets of Syracuse. For 98 years New York Central and West Shore trains have moved through the streets of the city. On Sept. 24 this new passenger terminal and the elevated right-of-way were put in service. The work was done as a part of New York State's program of grade crossing elimination, the state paying half the cost and the railroad half. The New York Central and the West Shore Railway have combined to operate over the West Shore right-of-way. The New York Central tracks will be abandoned except for certain industrial tracks and connections. Three tracks are built on the elevated right-of-way, with 12 tracks at the new station. J. W. Pfau, chief engineer, New York Central Railroad, directed the work; A. D. Duffie was engineer in charge. The Walsh Construction Co. was the contractor.

No Bids on Oakland Tunnel

No bids were received by highway district No. 13 at Oakland, Calif., from its advertisement (*ENR*, Sept. 3, 1936, p. 351) for bids to be opened Sept. 11 for completion of the Broadway highway tunnel.

Work on the tunnel was abandoned on June 13 by the original contractor, Six Companies of California, Inc., the contractors alleging that ground conditions were not as represented (*ENR*, June 25, 1936, p. 933). At the time of abandonment, the contract had passed its completion date and liquidated damages of $500 per day were being assessed against the contractor.

The work involved consists of a vehicular tunnel 3,168 ft. long and 2.2 miles of roadway. The original contract was for $3,683,931. Cost of completing the work is estimated at more than $1,500,000.

Regulations for Walsh-Healey Act

Construction work is exempted from the provisions of the act, according to regulations issued by Secretary of Labor

PROVISIONS of the Walsh-Healey government contract act apply only to manufacturers of, or dealers in, materials, supplies and articles concerned in the contract, according to regulations issued by Secretary of Labor Perkins. The act becomes effective Sept. 28, and thereafter all invitations for government contracts to which the act applies will be accompanied by the stipulations of the act. Construction contracts will definitely not be affected for the Bacon-Davis prevailing wage act still applies on federal building work, and general construction contracts are not regarded as for materials or supplies.

A brief outline of the regulations follows. In most respects they are as indicated in an advance interpretation of the act published in these pages Sept. 3, 1936, p. 348.

1. The contractor must be either a manufacturer of, or a dealer in, the materials, supplies, articles, and equipment concerned in the contract.

2. In fulfilling the contract he must, insofar as direct labor is concerned, avoid the knowing employment of convicts or of male or female workers under the ages of 16 and 18, respectively. This requirement does not extend to office or custodial employees not directly connected with production, supervision or shipment, nor does it extend beyond the employees of the principal contractor to cover sub-contractors or material suppliers.

3. He must comply with safety, sanitary and factory inspection laws of the locality where the work is performed.

4. He must adhere to a work schedule not exceeding 8 hr. per day and 40 hr. per week, or else pay overtime wages for any excess at a rate 1½ time the normal scale.

The fifth requirement in the law, providing for the payment of not less than the prevailing wage rates as determined by the Secretary, is suspended for an indefinite period. Before it can be enforced in any industry there must be investigations, public hearings, and a formal determination by the Secretary.

Provisions of the new law will not apply to all government contracts. Exempt are contracts relating to: (1) transactions amounting to less than $10,000; (2) construction; (3) perishables, including dairy, livestock, and nursery products; (4) agricultural products processed by the original producer; (5) common-carrier transportation and communication; (6) public-utility services; (7) contracts performed outside of the United States. The Secretary has authority to grant individual and blanket exemptions at her discretion when necessary in the public interest or to avoid injustice.

Principal criticism of the new regulations involves an alleged "re-writing" of the law by Secretary Perkins in her interpretation of the clause exempting from the act "materials, supplies, articles and equipment such as may usually be purchased in the open market." This can be interpreted to exclude such items as cement, structural steel, typewriters, motor trucks, and many other articles normally manufactured in accordance with standard practice and stored for subsequent sale to anyone. This loophole is closed by the Secretary's interpretation of the language as an exemption applying only to those small routine orders, usually on an emergency basis, that government purchasing agents can legally make without advertising for bids. If the law gets to the courts, it will probably be for an interpretation of this particular ruling.

But if this loophole is closed, there is another in which the producers of stable goods can find ample refuge. When the successful bidder is a regular dealer in the goods concerned, the restrictions affect his employees only and do not extend back to the manufacturer from whom he buys. So in the field of staple products, even though they are not exempted as such by the regulations, it seems probable that dealers, rather than manufacturers, will be the government contractors of the future.

Philip Wilson Dies

Philip St. Julian Wilson, who was largely responsible for the adoption of the federal-aid highway system and has served the Bureau of Public Roads as chief engineer since 1916, died September 16 at his home in Washington.

Born in Powhatan County, Virginia, on May 30, 1867, Mr. Wilson graduated from Virginia Military Institute in 1886. He was in general engineering practice in Suffolk, Va., until the Spanish-American war, during which he commanded the 4th Virginia Infantry. Returning, he started practicing his profession in Richmond, becoming city engineer in 1902. In 1906 he was appointed commissioner and chief engineer of the Virginia State Highway Commission, serving with it during the development of the primary road system of that state.

In 1913 Mr. Wilson became assistant director of the newly-organized Bureau of Public Roads and became active as a proponent of the federal-aid system. His acquaintance with the Virginia delegation, then very powerful in Congress, was of great help in getting this new conception approved by that body. He became chief engineer of the Bureau in 1916, and has served in that capacity ever since.

Captain Wilson was a member of the American Association of State Highway Officials and of the Washington Society of Engineers.

SOCIETY CALENDAR

PUBLIC WORKS CONGRESS, joint meeting, AMERICAN SOCIETY OF MUNICIPAL ENGINEERS AND INTERNATIONAL ASSOCIATION OF PUBLIC WORKS OFFICIALS, Toronto, Ont., Sept. 28-30.

CANADIAN INSTITUTE ON SEWAGE AND SANITATION, Royal York Hotel, Toronto, Oct. 1-2, 1936.

INTERNATIONAL CONGRESS ON THE BUILDING OF STRUCTURES ABOVE GROUND, Berlin, Germany, Oct. 1-8.

INTERNATIONAL CONFERENCE ON STEEL CONSTRUCTION, Berlin, Germany, Oct. 2-7.

INTERNATIONAL ASSOCIATION FOR BRIDGE AND STRUCTURAL ENGINEERING, second congress, Berlin, Germany, Oct. 1-11.

NATIONAL SAFETY CONGRESS, annual meeting, Atlantic City, N. J., Oct. 5-9.

NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS, annual convention, Washington, D. C., Oct. 12-13.

AMERICAN SOCIETY OF CIVIL ENGINEERS, fall meeting, Pittsburgh, Pa., Oct. 13-17.

NATIONAL COUNCIL OF STATE BOARDS OF ENGINEERING EXAMINERS, annual meeting, Knoxville, Tenn., Oct. 19-21.

AMERICAN WELDING SOCIETY, annual meeting, Cleveland, Ohio, Oct. 19-23.

AMERICAN PUBLIC HEALTH ASSOCIATION, annual meeting, New Orleans, La., Oct. 20-23.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION, annual convention, White Sulphur Springs, W. Va., Oct. 21-23.

HIGHWAY RESEARCH BOARD of the NATIONAL RESEARCH COUNCIL, annual meeting, Washington, D. C., Nov. 18-20.

AMERICAN WATER WORKS ASSOCIATION, NEW JERSEY SECTION; NEW JERSEY WATER WORKS ASSOCIATION; and the SOUTH JERSEY ASSOCIATION OF WATER SUPERINTENDENTS; joint meeting, Atlantic City, N. J., Oct. 23-24.

CENTRAL STATES SEWAGE WORKS ASSOCIATION, annual meeting, Indianapolis, Ind., Oct. 29-30.

EXAMINATIONS for registration as Engineers, Land Surveyors and Architects will be held as follows:

NEW YORK STATE, examination for professional engineers and surveyors, Jan. 25-27, at Albany, Buffalo, New York City and Syracuse. Applications must be filed with the State Education Department at Albany before Nov. 1.

Byllesby Changes Name

The board of directors of Byllesby Engineering & Management Corp. voted on Sept. 16 to change the name of the organization to Public Utility Service Corp. D. W. Lynch was elected president of the new corporation succeeding John J. O'Brien, formerly president of Byllesby Engineering & Management Corp., who died on Aug. 7. The purpose of the change in name is to indicate more clearly the existence of Public Utility Service Corp. as a separate and distinct organization from H. M. Byllesby & Co., the investment banking house.

Roosevelt Endorses Seaway

Proponents of the St. Lawrence waterway project met with President Roosevelt on Sept. 23 to present a long letter reviewing the arguments in favor of the project and expressing confidence that the treaty with Canada will be ratified at the coming session of Congress.

In his answering letter, the President stated that "I subscribe wholeheartedly to this declaration of the Seaway Council. . . . It is my very earnest hope that negotiations for the St. Lawrence project may be carried forward within the coming year to a successful and final conclusion."

Contract Let for Bridges On Pan-American Highway

The Bureau of Public Roads has awarded a contract to the United States Steel Products Co. for fabrication and erection of the steel superstructure of three bridges on the Pan-American highway on a bid of $387,790.

The bridges involved were described in *ENR*, July 9, 1936, p. 65. They are: a 730-ft. bridge over the Chiriqui River in Panama, of which the principal span is a 400-ft. cable suspension. A bridge over the Choauteca River in Honduras, 930-ft. long, with two principal suspension spans each 330 ft. long. A 440-ft. bridge over the Tamaculapa River in Guatemala, of which the principal span is an eye-bar suspension span 240 ft. long. All three bridges have 20-ft. roadways. The first two have double sidewalks, and the third has none.

The contract was awarded two weeks ago, but no announcement was made at that time.

Federation Continues School

The Federation of Architects, Engineers, Chemists and Technicians (119 E. 18th St., New York City) is offering again this fall a group of courses in preparation for the New York State architects' and engineers' licence examinations. These courses were offered for the first time in February, 1936. The courses in civil engineering include structural design and analysis of statically indeterminate structures. Other courses will be arranged if application is made for them by a sufficient number of students.

The school is operated on a cooperative basis, such portion of the fees as are not required to meet expenses being returned at the end of the year.

Brief News

FINAL APPROVAL of plans for the $1,222,000 Tifft St. grade crossing elimination project in Buffalo, N. Y., has been received from federal and state authorities. Bids for the project, one of the largest of its kind in Buffalo, will be opened Sept. 25, in Albany. Construction is expected to get under way by the middle of October. The entire cost will be borne by the Federal government with state officials supervising the job. The plan provides for an overhead viaduct, 3,700 feet long, with a 40-foot roadway, exclusive of sidewalks, over the tracks of the Lehigh Valley, New York Central, Erie, Nickel Plate, Baltimore & Ohio, and South Buffalo railways.

THE WESTERN SOCIETY OF ENGINEERS on Aug. 27 adopted a resolution endorsing the revised building code now pending before the Chicago Common Council. The resolution, copies of which were sent to the mayor of Chicago, stated that the delay in passage of the bill is seriously retarding recovery of the building industry in Chicago and that its prompt passage "would greatly stimulate building construction in Chicago and reduce the serious amount of unemployment which still exists." The Society, therefore, urged the prompt adoption of the code. Mayor Kelly of Chicago, in his reply, expressed his complete concurrence with the views of the Society and stated that he was making every effort to speed the adoption of the new code. The delay, he stated, was due to the fact that "legislative bodies seem to move very slowly on major matters of this kind."

Washington Highlights

by Paul Wooton

Appointment of a special committee to carry on the studies initiated by the Great Plains Drought Area Committee and to recommend legislation for submission to the next Congress was announced by President Roosevelt on September 20, coincident with the appointment of a separate committee to prepare a plan for crop insurance. Personnel of the new drought committee is based upon the membership of the original temporary committee, although it is somewhat smaller. Morris L. Cooke remains as chairman. The committee will report to the President by January 1, 1937.

Although legislation for the disposition of surplus power from the Bonneville project on the Columbia River failed of passage at the last session of Congress, the Federal Power Commission, by direction of President Roosevelt, is starting a detailed study to form a basis for the determination of wholesale rates to be charged. It is expected that a report will be ready by the time that the next Congress convenes.

Several bills placing the operation of the project in the hands of the Corps of Engineers and the determination of rates under the Federal Power Commission were introduced into Congress this spring but failed of enactment in the last-minute rush. It is expected that a similar measure will be introduced soon after the next Congress convenes. However, the fact that power will be available for marketing in the fall of 1937 makes it advisable to determine now the rate to be charged in order that contracts may be negotiated with prospective customers.

As part of its study, the Commission will consider the proposal of the National Resources Committee for a regional grid system.

Contract Awarded For General Motors N. J. Plant

The general contract for the construction of the new assembly plant of the General Motors Corp. at Linden, N. J. (*ENR*, Sept. 3, 1936, p. 350) has been awarded to J. A. Utley Co. of Detroit.

The plant will be used for assembling Buick, Oldsmobile, and Pontiac cars for the Eastern states and for export; it will have a capacity of 120,000 cars per year.

Four buildings are to be constructed on the 80-acre tract, a main factory, an office building, a loading dock, and a power house. There will also be a test track. Construction will begin at once, and it is expected that the plant will be completed in January.

Albert Kahn of Detroit is the architect.

Personals

SHERIDAN P. GORMAN has been named acting director of the WPA in Virginia.

LT. COL. G. E. EDGERTON, Corps of Engineers, has been appointed engineer of maintenance for the Panama Canal Zone.

A. S. HARRINGTON has been appointed project manager of the Middle Loup Public Power and Irrigation District with headquarters at Arcadia, Neb.

HARRY H. SCHOEN of Charleston, S. C., has been enrolled as a lieutenant commander in the Civil Engineer Corps of the United States Navy.

ARTHUR K. ERB has been appointed senior staff engineer of the Sixth WPA district of West Virginia. WILLIAM C. MCBRIDE and FRED O. MITCHELL have been appointed junior staff engineers of the same district.

Z. B. THOMPSON, formerly district maintenance engineer at Selmer, Tenn., for the Tennessee state highway department, has been transferred to Memphis, Tenn., as resident engineer in charge of construction of the Florida St. underpass.

GEORGE W. TRAYER, who for the past 16 years has been on the research staff of the Forest Products Laboratory of the United States Forest Service at Madison, Wis., has been appointed chief of the Division of Forest Products of the United States Forest Service.

E. H. DUNMIRE, who has been associated for the last 16 years with the consulting firm of Black & Veatch of Kansas City, Mo., has left that firm to accept an appointment as engineer-manager of the North Loup Public Power and Irrigation District at Ord, Neb.

Obituary

STEPHEN BURWELL COON, Toronto architect and engineer, died on Sept. 7 at the age of 74.

WILLIAM HAUCK, deputy chief engineer of the New York City Department of Water Supply, Gas & Electricity, died in New York City on Sept. 17 at the age of 62. Mr. Hauck was a graduate of Har-

yard. He had been associated with the department for the past 30 years.

ALBAN B. PLEASANTS, 52, assistant director of public works for the city of Norfolk, Va., died there on Sept. 16. Mr. Pleasants was connected for a number of years with the engineering department of the Atlantic Coast Line before taking the position in Norfolk.

HORACE C. GARDNER, an engineer and architect of Chicago, died in that city on Sept. 20 at the age of 79. From 1909 until his retirement in 1931, Mr. Gardner was a member of the firm of Gardner & Lindberg, industrial engineers and architects. Mr. Gardner served for many years as president of the Great Lakes-St. Lawrence Tidewater Association.

WILLIAM F. REEVES, assistant engineer in the legal department of the Interborough Rapid Transit Co. of New York City, died in New York on Sept. 18 at the age of 72. Mr. Reeves entered the employ of the Manhattan Railway Co. in 1880 as a civil engineer. He continued in this post when the company was taken over by the Interborough Rapid Transit Co. in 1903. Mr. Reeves acted for the Interborough as an authority on contracts and easements. He had been a member of the American Society of Civil Engineers since 1912.

CONSTRUCTION STATISTICS FOR THE WEEK

ENGINEERING construction awards total $68,041,000; this is the second highest volume for any week this year and is reached without benefit of large federal projects. In fact the volume is due to private awards breaking last week's 6-year record with a private total for this week of $36,823,000. State and municipal awards also are higher at $25,717,000. Federal awards at $5,501,000 bring total public awards up to $31,218,000. Corresponding volume for a year ago is: total, $27,755,000; private, $3,694,000; public, $24,061,000; state and municipal, $20,300,000; federal, $3,741,000.

Commercial buildings still hold the spotlight and break last week's high record with a total for this week of $22,352,000. The activity of a number of large speculative building developments in New York and New Jersey is in good measure responsible for this heavy increase in volume. Industrial buildings also are higher, however, at $12,175,000 and public buildings at $6,139,000. Highway awards increased to $13,020,000 and sewerage, bridges and unclassified construction are higher this week. Classification subtotals are: bridges, $4,138,000; sewerage, $2,179,000; waterworks, $912,000; earthwork, drainage, $2,497,000; unclassified, $4,629,000.

The larger awards for the week include: factory, Kelvinator Corp., Detroit, Mich., $600,000; furniture exchange, Capital Co., San Francisco, Calif., $2,000,000; auto assembly plant, General Motors Corp., Detroit, at Linden, N. J., est. $5,575,000; rack house, Hiram Walker & Sons, Peoria, Ill., est. $900,000; 90 air conditioned dwellings, Housing Corp., Teaneck, N. J., $500,000; 300 dwellings, Levitt & Sons, Manhasset, N. Y., $1,000,000; interior finish, plastering, partitions, elevators, etc., 32 story City Hall, Kansas City, Mo., $1,271,000; addition to U. S. Veterans' Hospital, Northport, N. Y., $1,343,000; highways, Mississippi, $1,453,000 and $1,668,000; Pennsylvania, $1,126,000; New Jersey, $544,000; bridges, Mississippi, $733,000; Tennessee, $420,000; Minneapolis-St. Paul Sanitary District, Contract 116, Division G; contracts 116-A, 116-D, 5 jobs, St. Paul, Minn., $1,398,000; Weehawken Plaza connections for Mid-Town Hudson Tunnel, New York, $1,237,000.

New capital includes state and municipal bond sales: $10,348,000 plus purchase from RFC of $4,461,000 in PWA bonds, corporate security issues, $122,000 and PWA allotments $10,242,000, a total or $20,712,000 as the net increase in new capital for the week ending Sept. 22.

CONTRACTS

(Thousands of Dollars)

	Weekly Average Sept. 1935	Prev. 4 Weeks	Week Sept. 24 1936
Federal Government	$9,191	$8,223	$5,501
State and Municipal	15,856	21,165	25,717
Total public	$25,047	$29,388	$31,218
Total private	3,663	14,872	36,823
Week's total	$28,710	$44,260	$68,041
Cumulative to date: 1935	$1,017,041,000	1936	$1,737,659,000

NEW PRODUCTIVE CAPITAL

(Thousands of Dollars)

1936	Week Sept. 24	Cumulative
State and municipal	$14,809†	$377,276
PWA non-federal	5,781†	86,527
RFC loans	....	26,663
Corporate issues	122	201,598
PWA loans, Private	....	—1,665*
Total Non-Federal	$20,712	$690,399
Federal	.....	691,237
Total new capital	$20,712	$1,381,636
Cumulative to date: 1935	$1,908,546,000	1936	$1,381,636,000

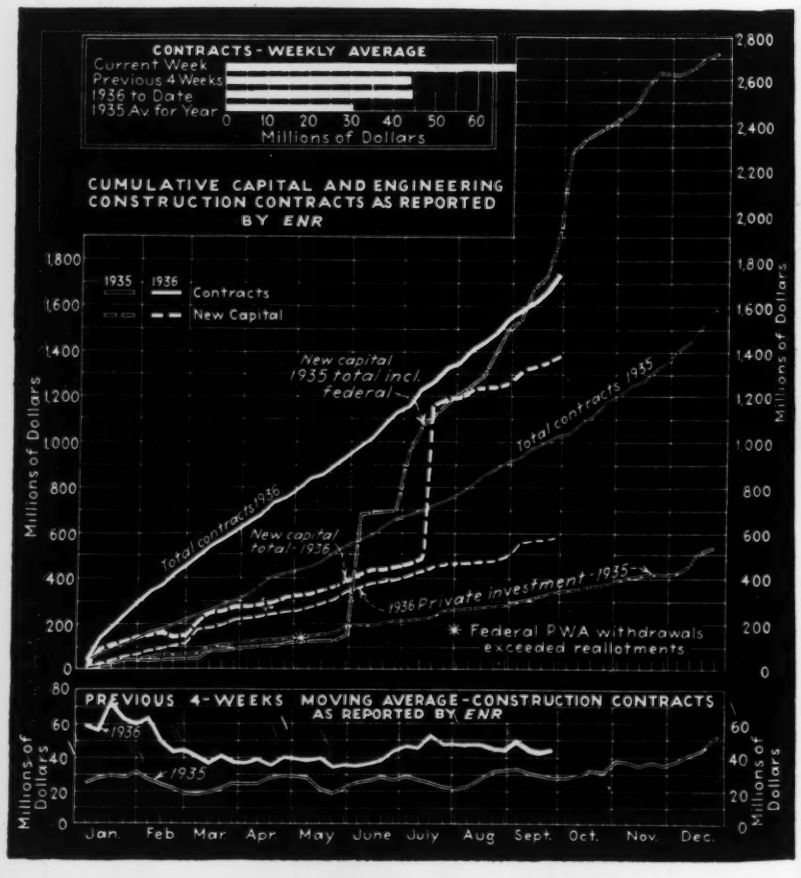
*Bond sales in this classification exceed reallotments during current year.

†Includes transfer from federal to private investment financing through sale by RFC of PWA bonds.

Note: These figures include private bonds, and stocks sold for productive purposes; state and municipal bonds for construction; PWA loans and grants to states and municipalities. RFC direct purchase of bonds for "self liquidating" projects, and 25 per cent of WPA construction appropriations.

INDEX NUMBER

ENR Cost	1913 = 100	1926 = 100	ENR Volume	1913 = 100	1926 = 100
Sept., 1936	208.10	100.03	Aug., 1936	199	87
Aug., 1936	208.10	100.03	July, 1936	188	82
Sept., 1935	195.10	93.82	Aug., 1935	140	61
1935 (Av.)	195.22	93.84	1935 (Av.)	135	58
1934 (Av.)	198.10	95.23	1934 (Av.)	114	50
1933 (Av.)	170.18	81.80	1933 (Av.)	102	47


CONTRACTS - WEEKLY AVERAGE
Current Week
Previous 4 Weeks
1936 to Date
1935 Av for Year
0 10 20 30 40 50 60
Millions of Dollars
CUMULATIVE CAPITAL AND ENGINEERING CONSTRUCTION CONTRACTS AS REPORTED BY ENR
1935 1936
Contracts
New Capital
New capital 1935 total incl. federal
Total contracts 1935
Total contracts 1936
New capital total 1936
1936 Private investment 1935
* Federal PWA withdrawals exceeded reallotments
Millions of Dollars
PREVIOUS 4-WEEKS MOVING AVERAGE-CONSTRUCTION CONTRACTS AS REPORTED BY ENR
1936
1935
Jan. Feb Mar Apr May June July Aug Sept. Oct. Nov. Dec.